

INVENTOR:
TITLE:

SERIAL NO.:
ATTORNEY:

FANGLI, AL.
METHOD AND APPARATUS FOR A MULTI-COMPONENT INDUCTION INSTRUMENT MEASURING
SYSTEM FOR GEOSTEERING AND FORMATION RESISTIVITY DATA INTERPRETATION IN
HORIZONTAL, VERTICAL AND DEVIATED WELLS
10/214,436
G. MICHAEL ROEBUCK
FILING DATE: AUGUST 7, 1998
DOCKET NO.: 414-15493-CIP
TELEPHONE NO.: 713-266-1130
REPLACEMENT DRAWINGS

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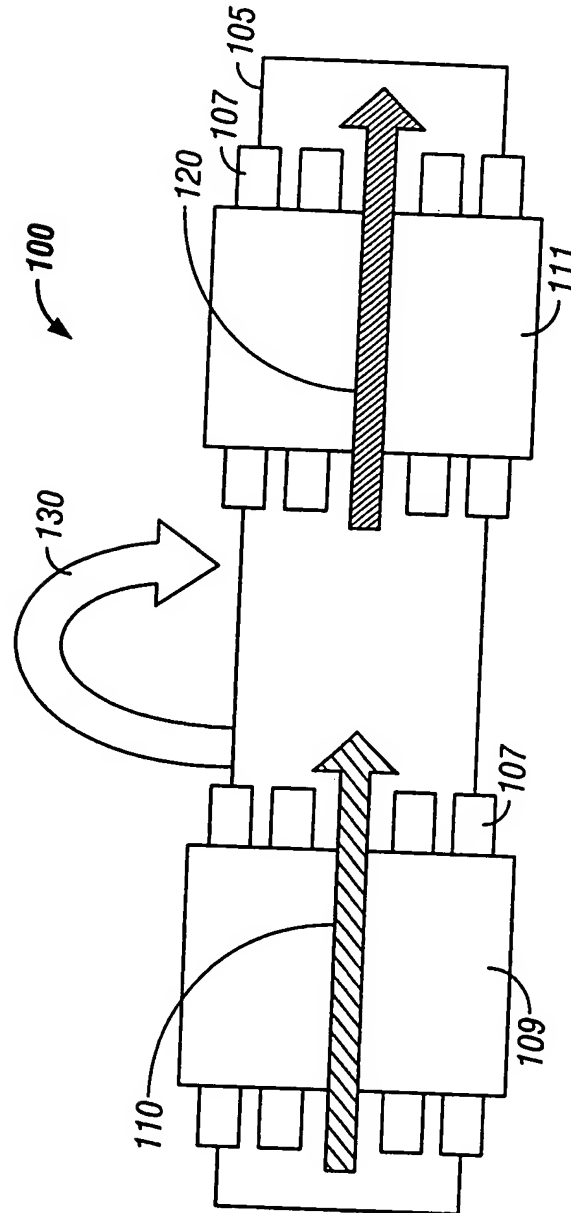


FIG. 1

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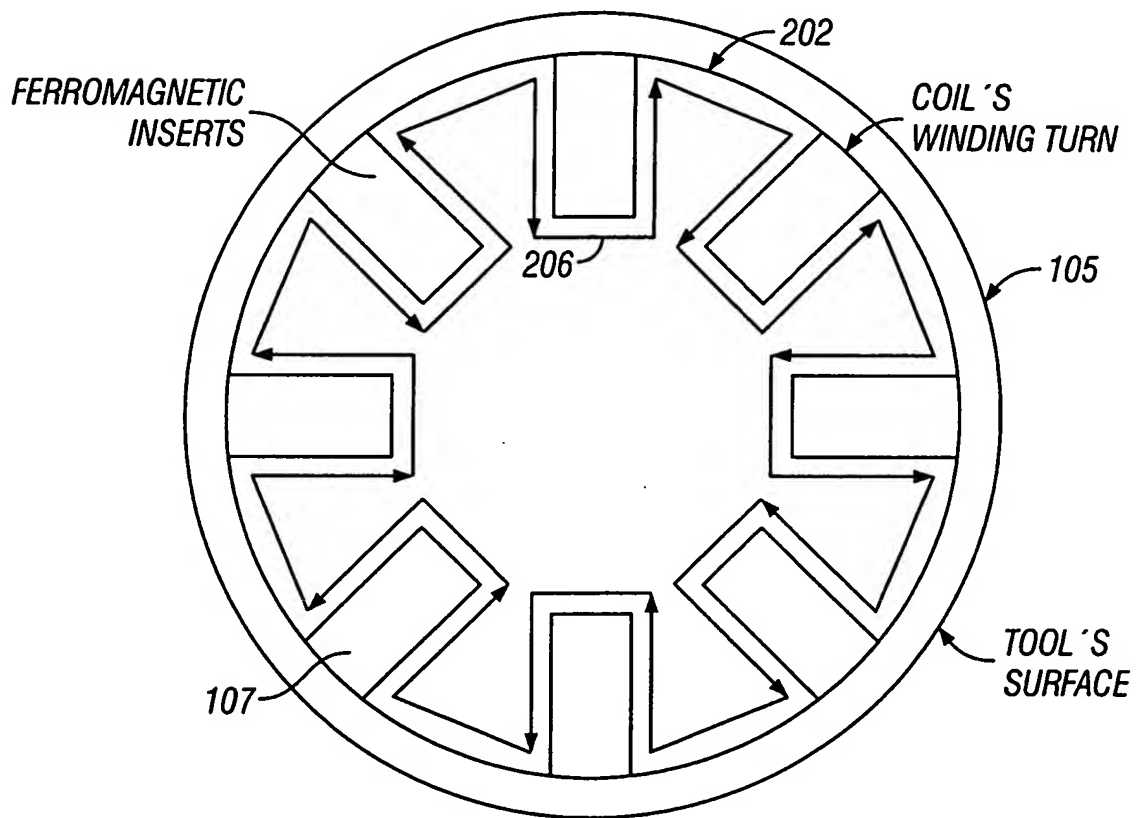


FIG. 2

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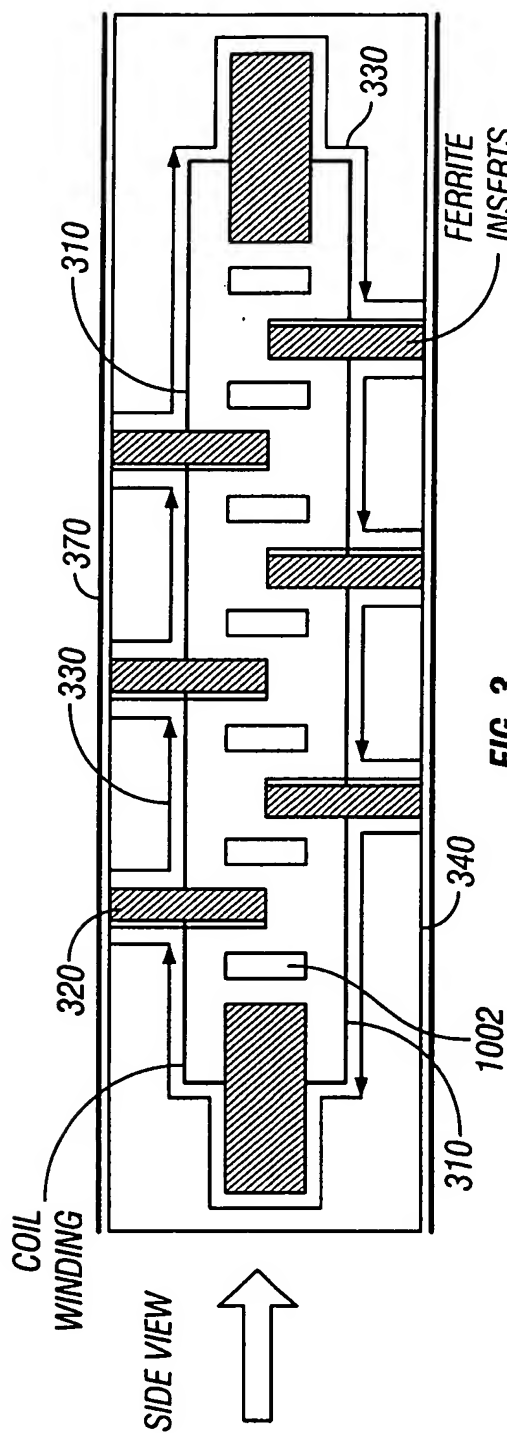


FIG. 3

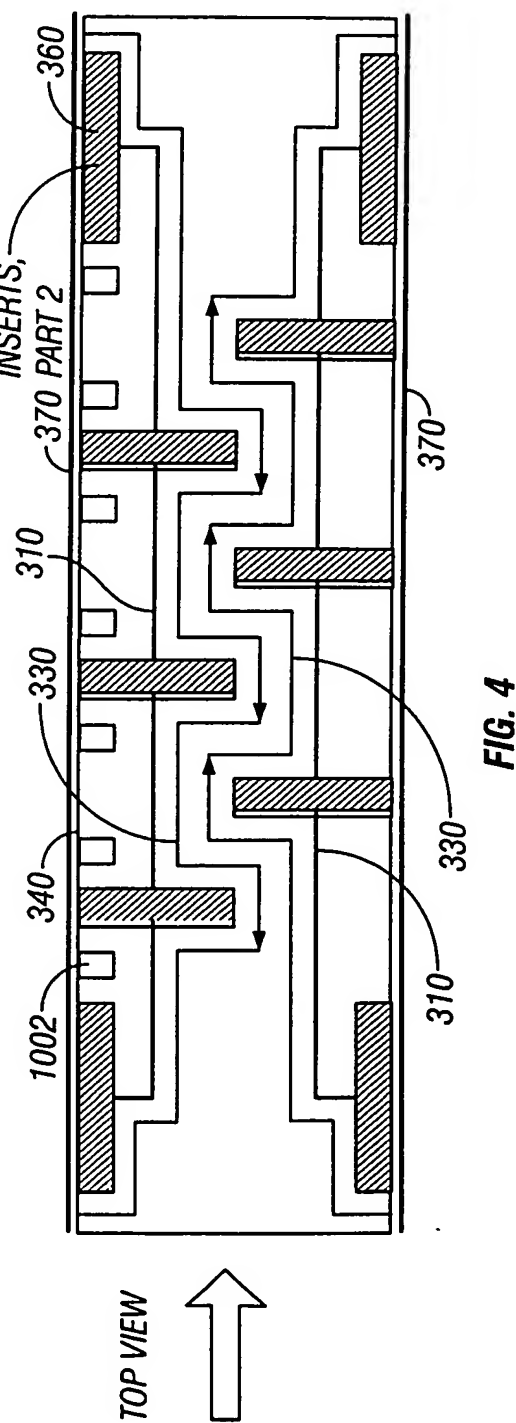


FIG. 4

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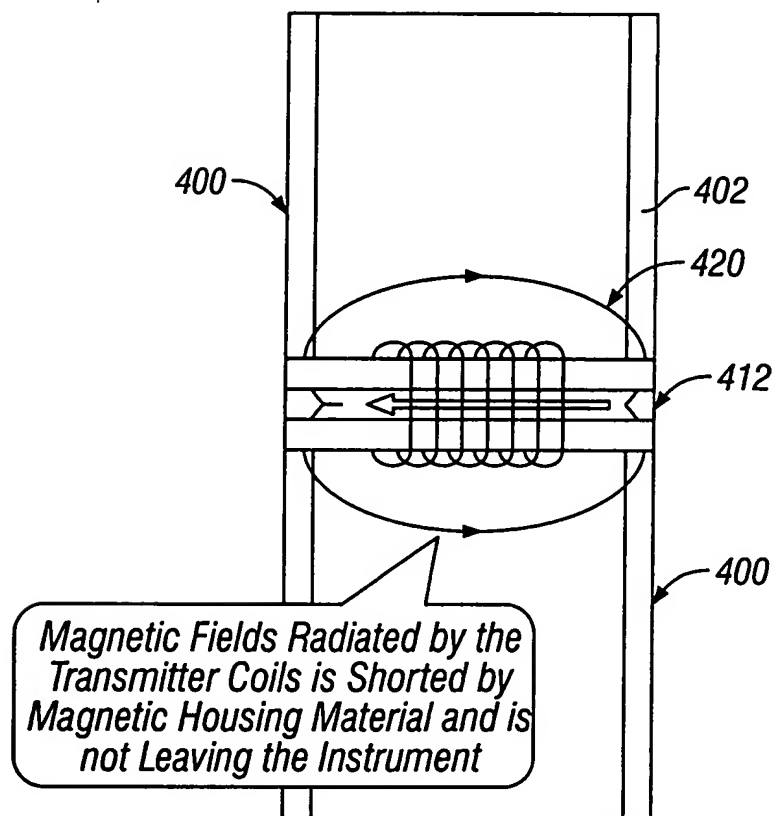


FIG. 5

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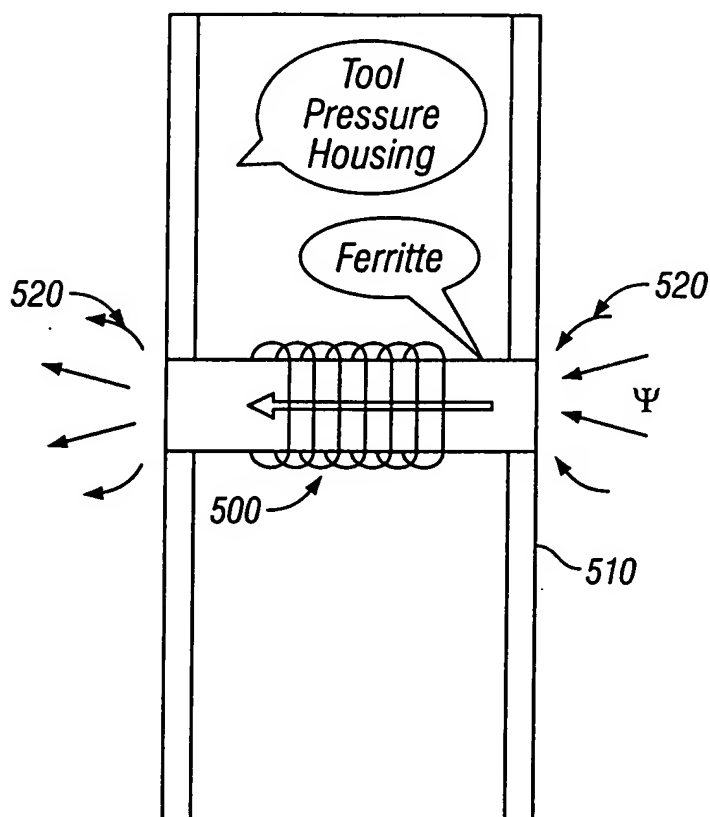


FIG. 6

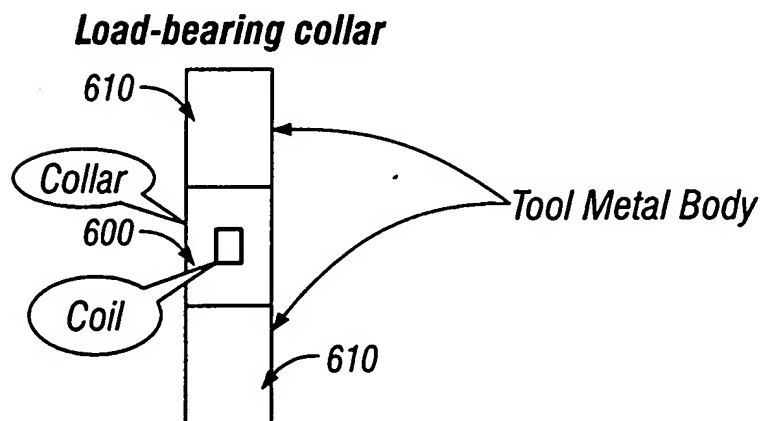


FIG. 7

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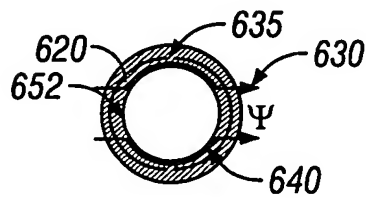
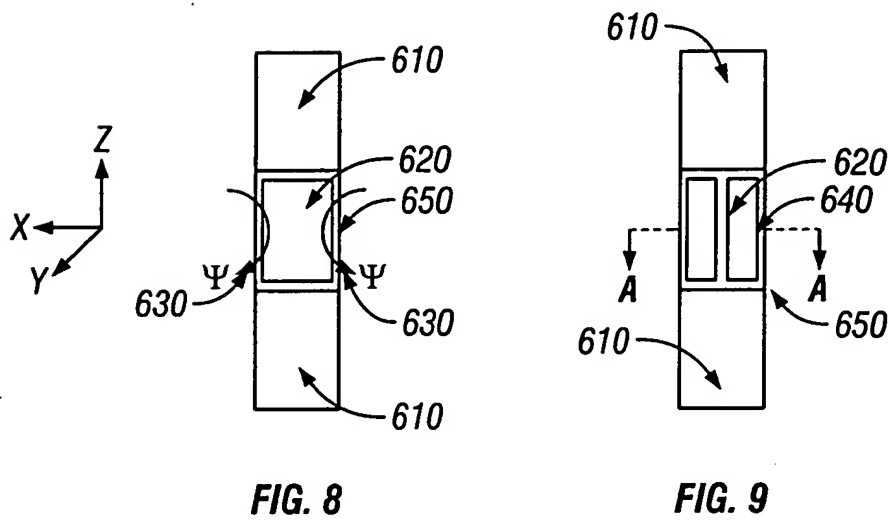


FIG. 10

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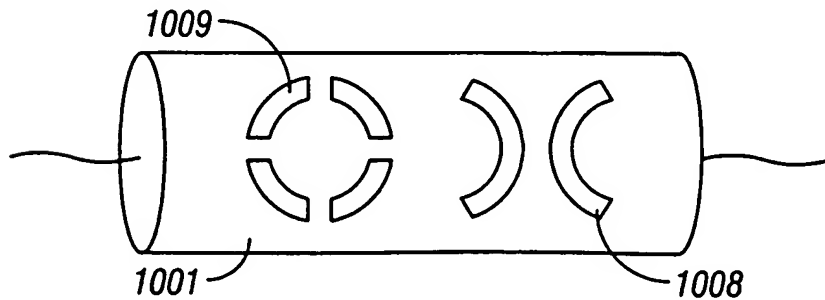
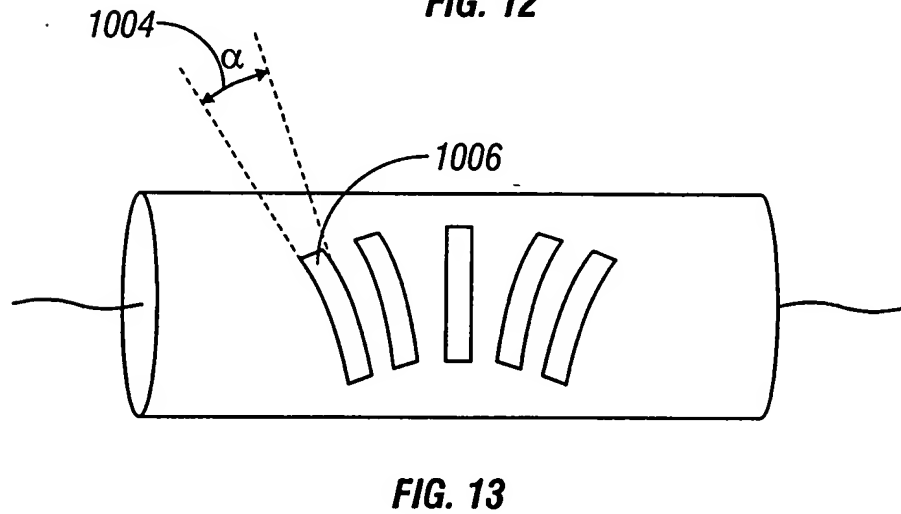
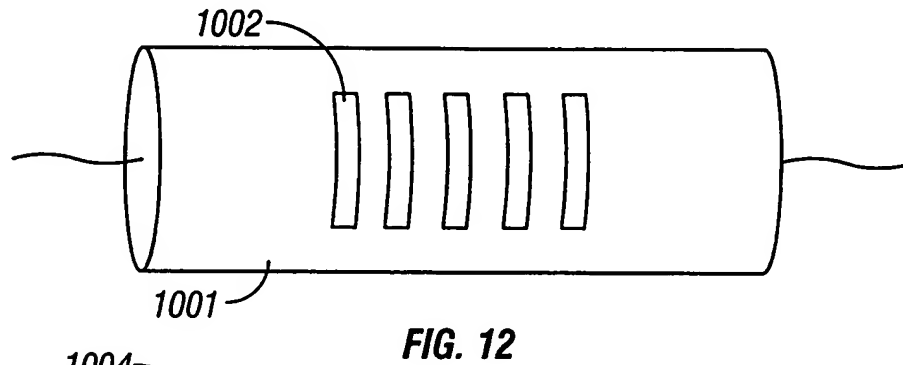
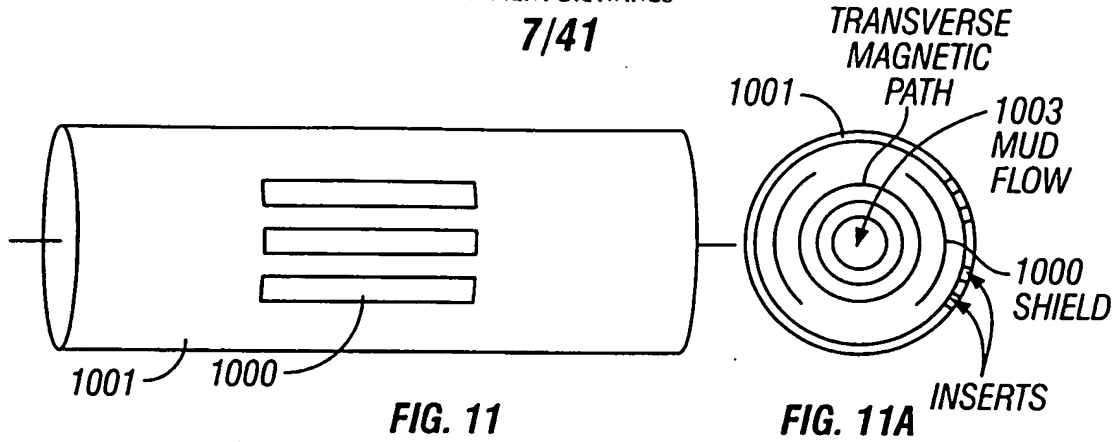


FIG. 14

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REPLACEMENT DRAWINGS

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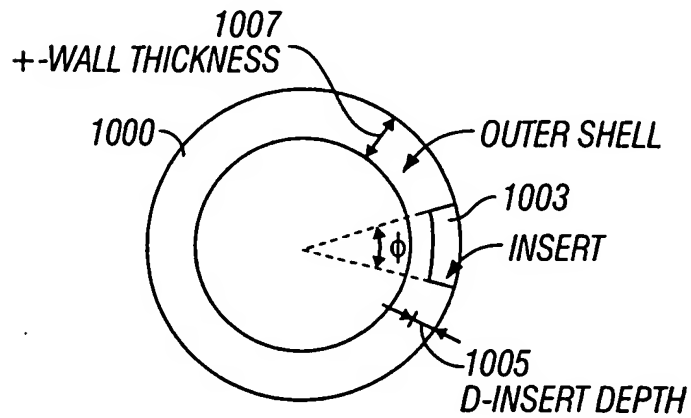


FIG. 15

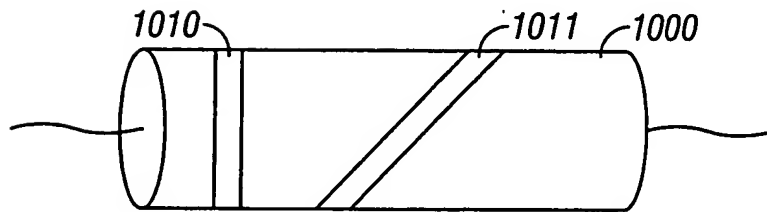


FIG. 16

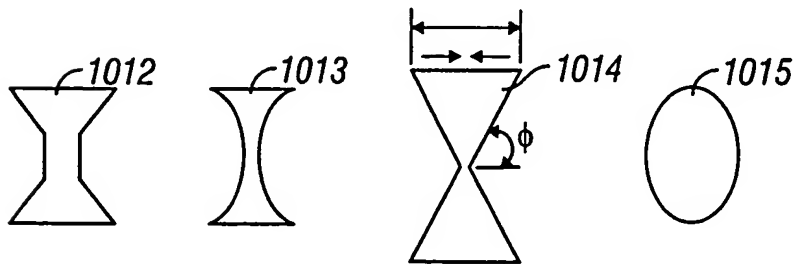


FIG. 17

FIG. 17A

FIG. 18

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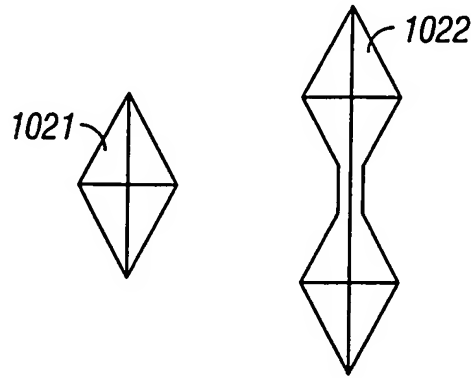


FIG. 19

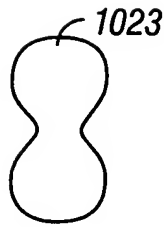


FIG. 20

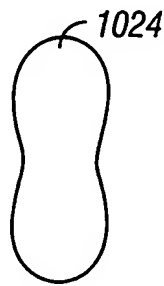


FIG. 20A

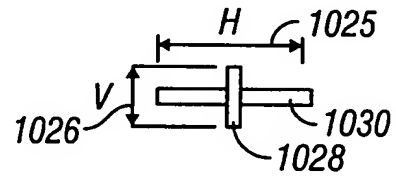


FIG. 21

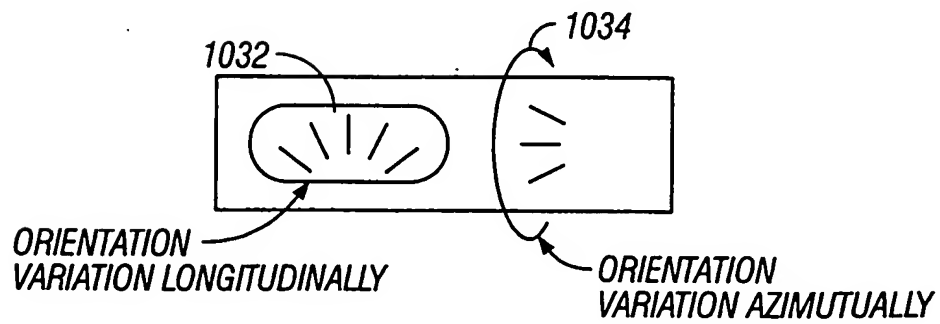


FIG. 22

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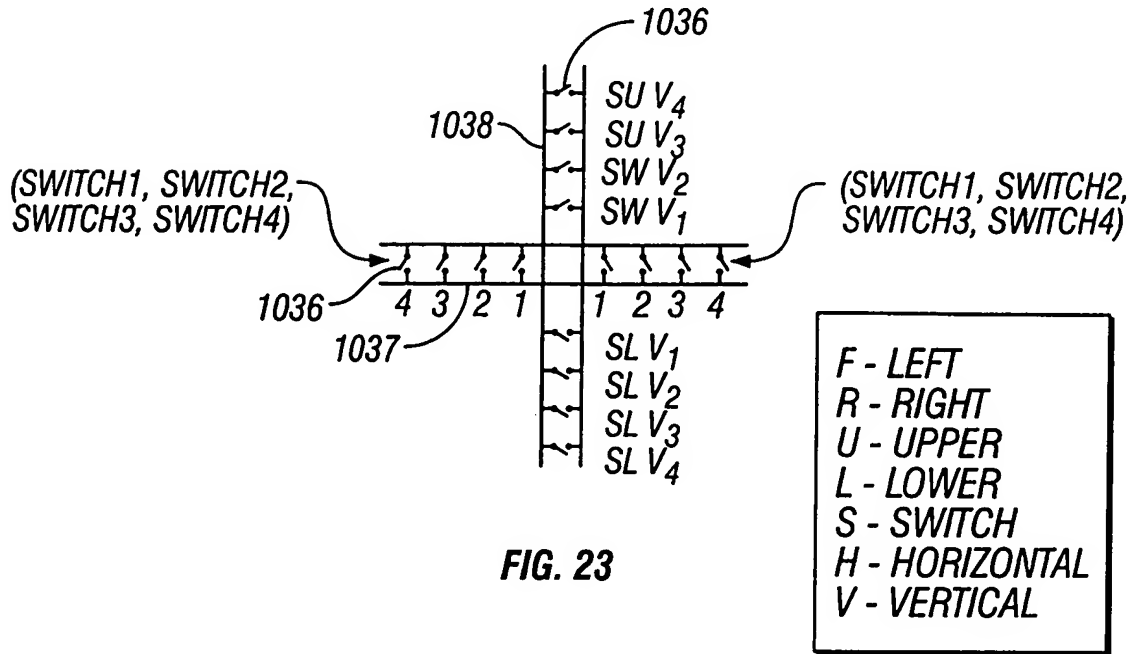


FIG. 23

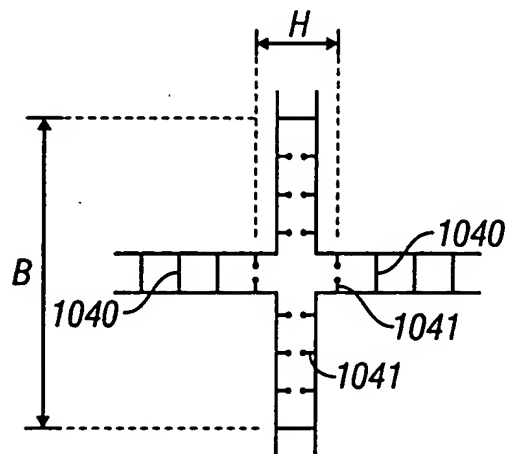


FIG. 24

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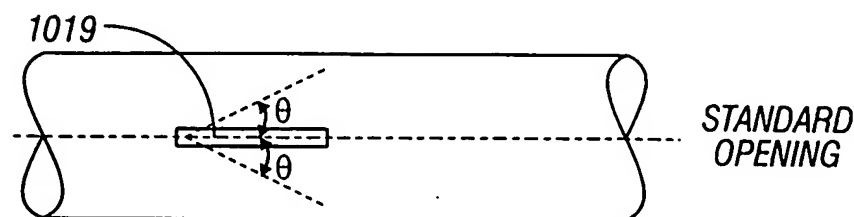


FIG. 25

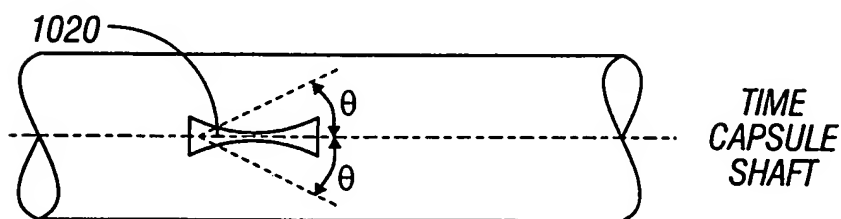


FIG. 26

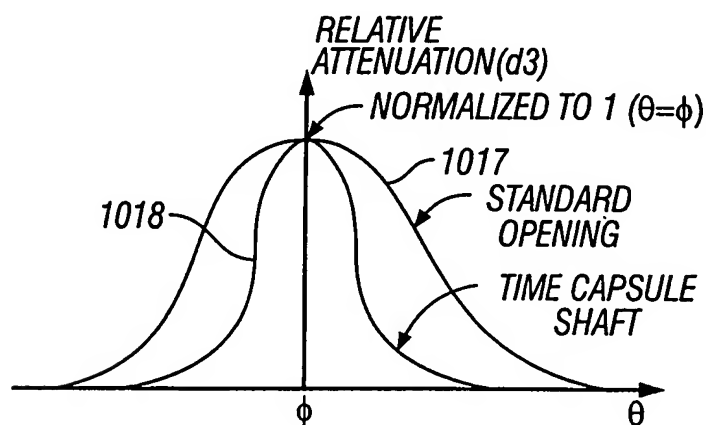


FIG. 27

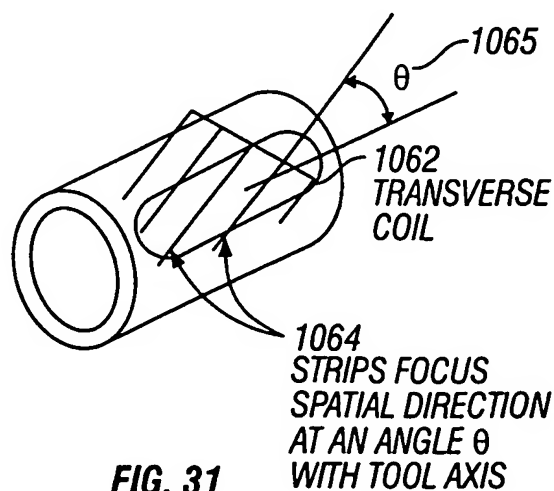


FIG. 31

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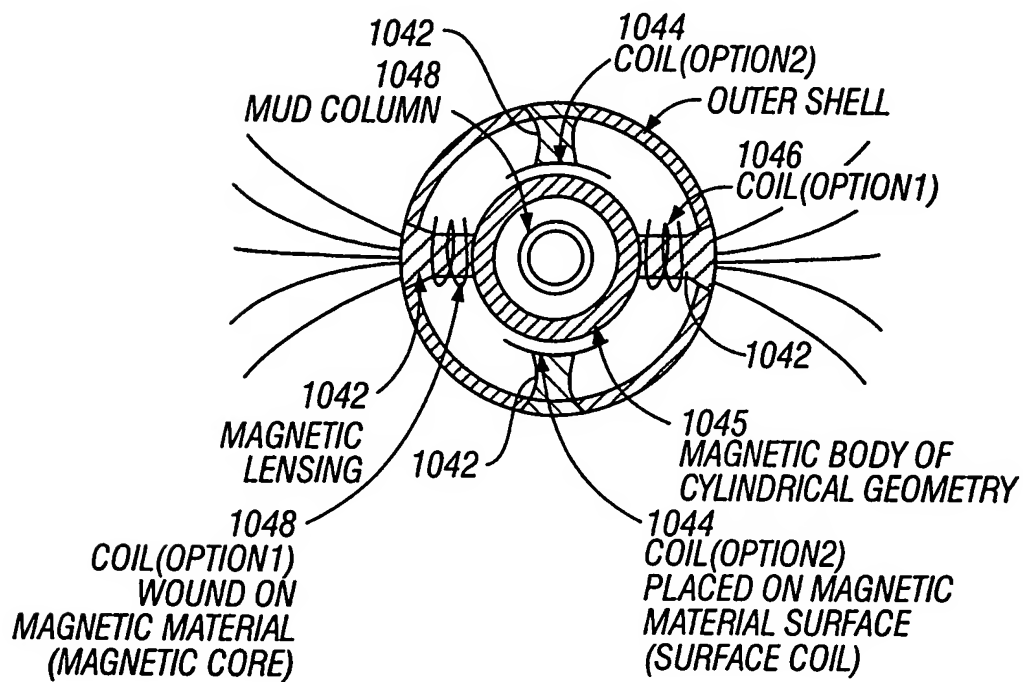


FIG. 28

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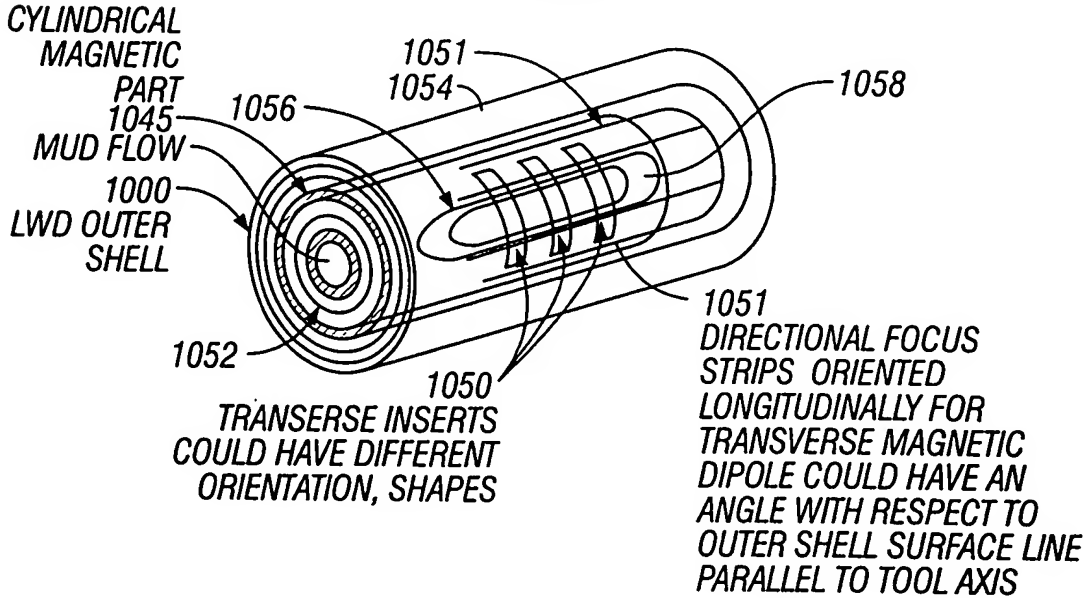


FIG. 29

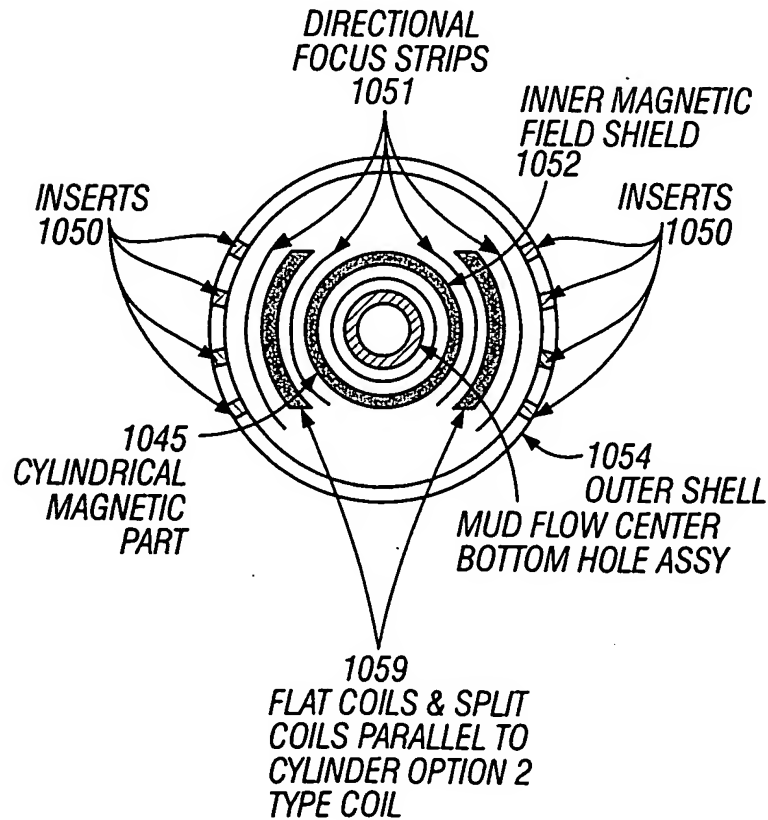


FIG. 30

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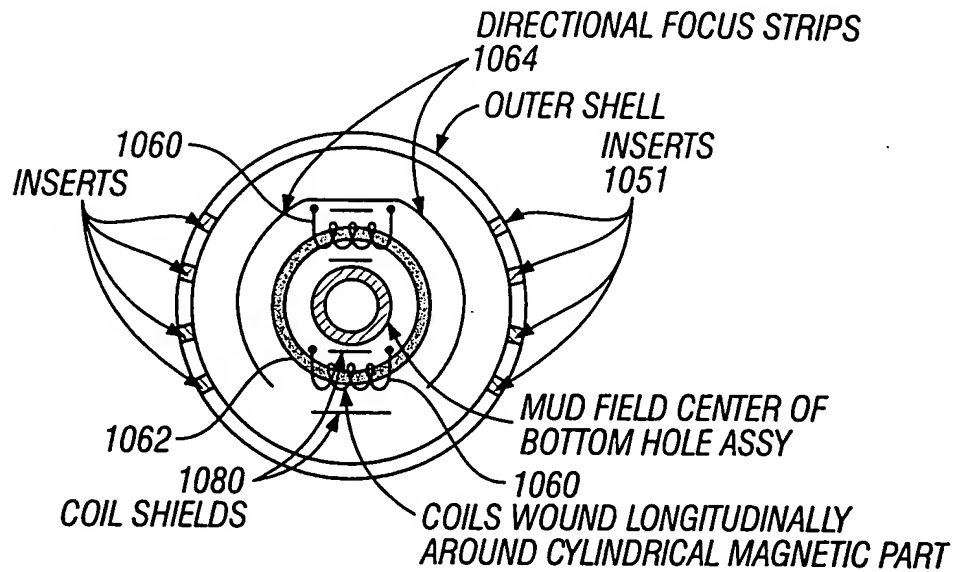


FIG. 32

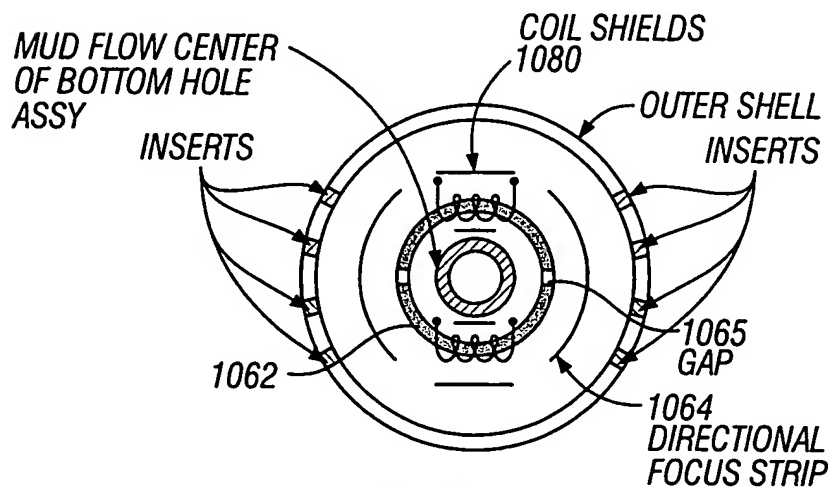


FIG. 33

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METHOD AND APPARATUS FOR A MULTI-COMPONENT INTERSECTION INSTRUMENT MEASURING
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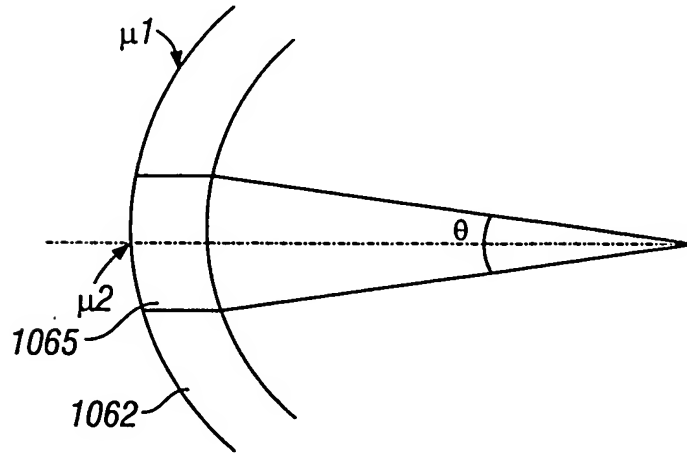


FIG. 34

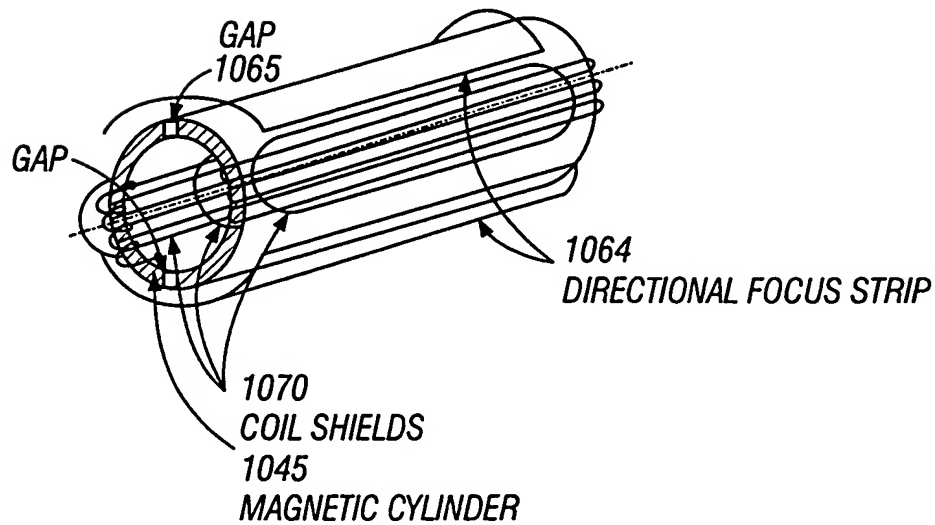


FIG. 35

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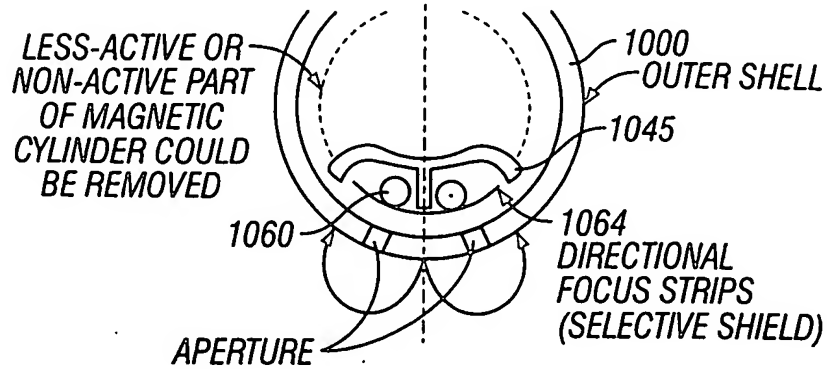


FIG. 36

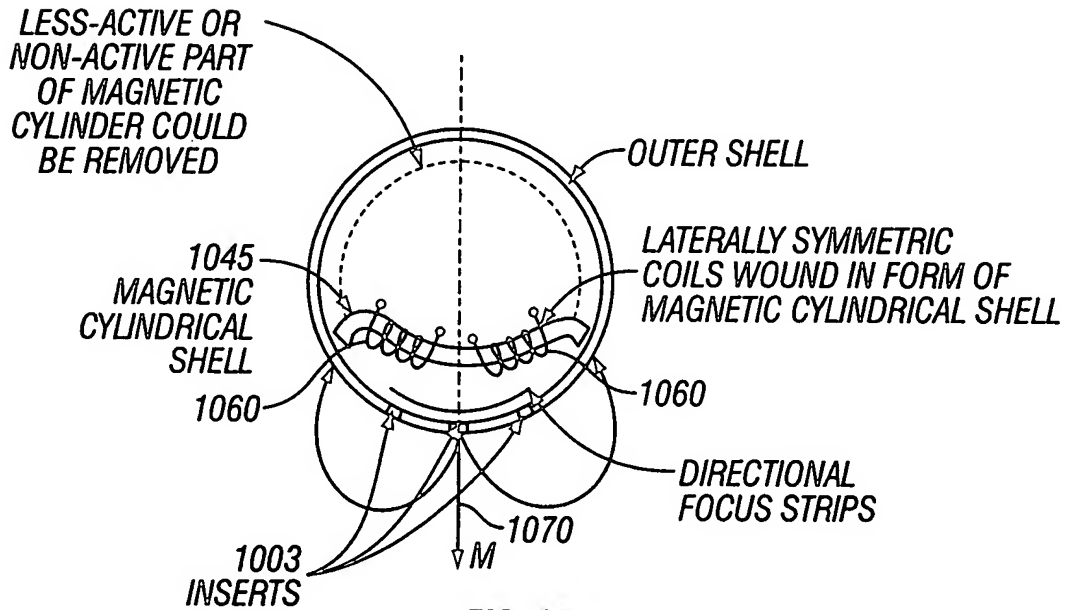


FIG. 37

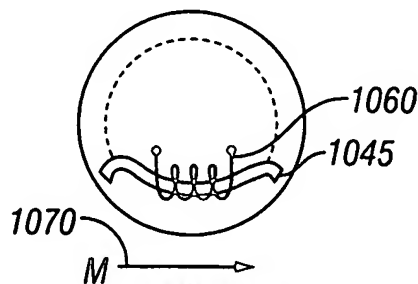


FIG. 38

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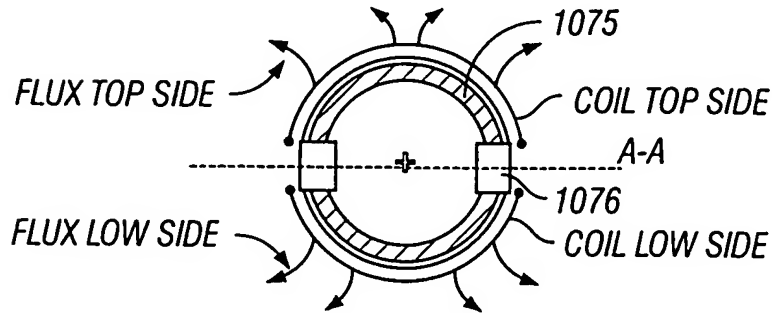


FIG. 39

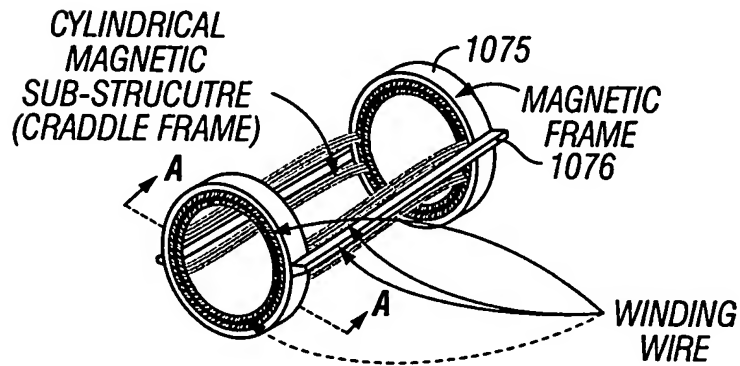


FIG. 40

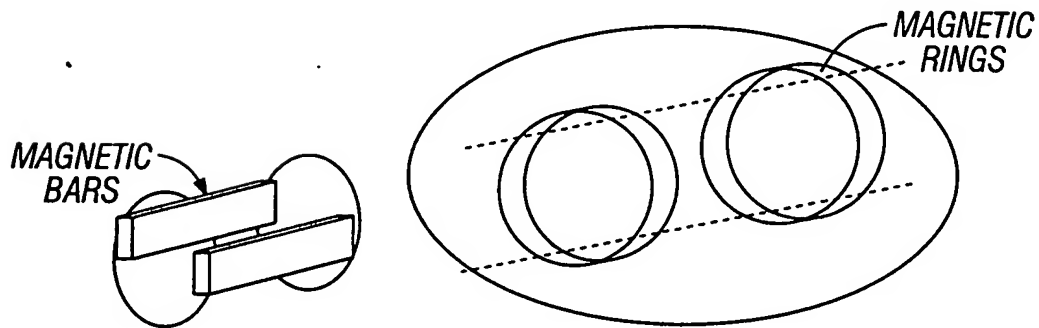


FIG. 41A

FIG. 41B

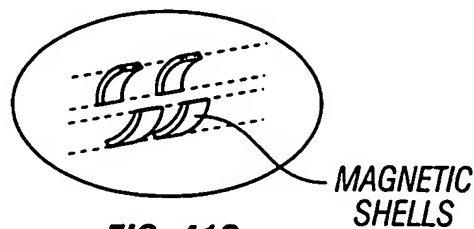


FIG. 41C

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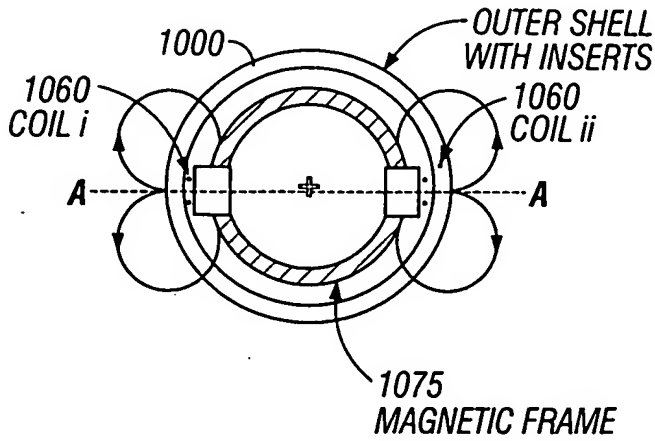


FIG. 42

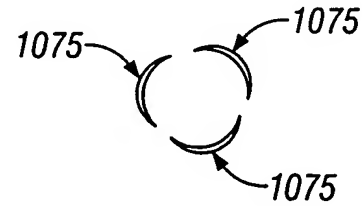


FIG. 43

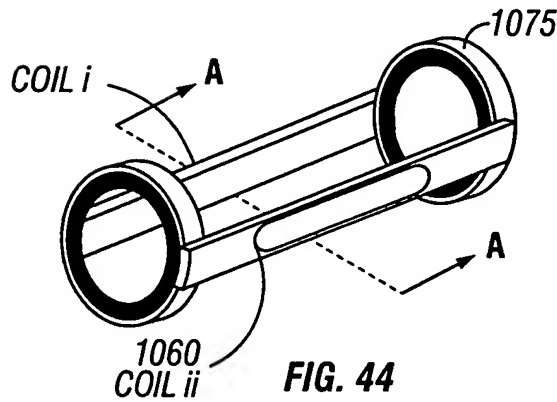


FIG. 44

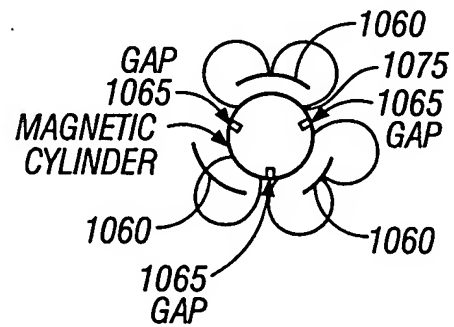


FIG. 45

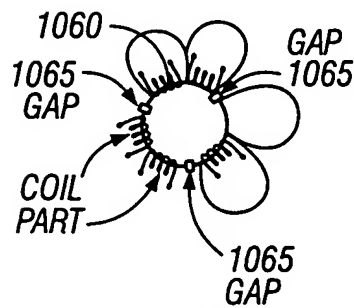


FIG. 46

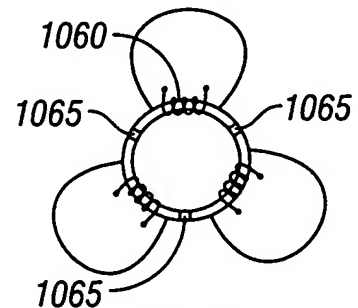


FIG. 47

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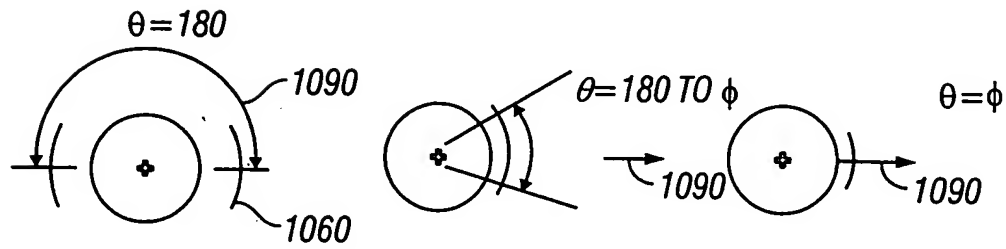


FIG. 48

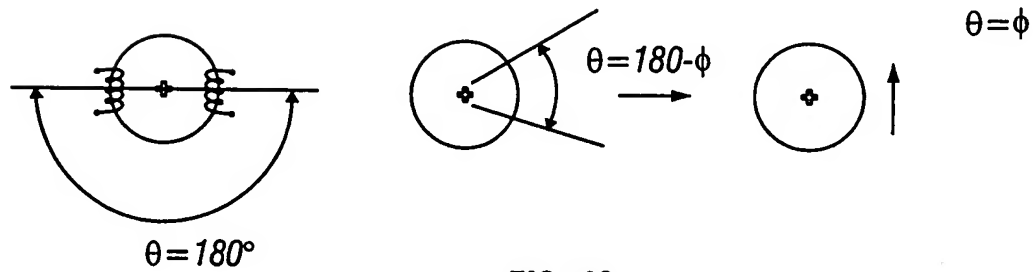


FIG. 49

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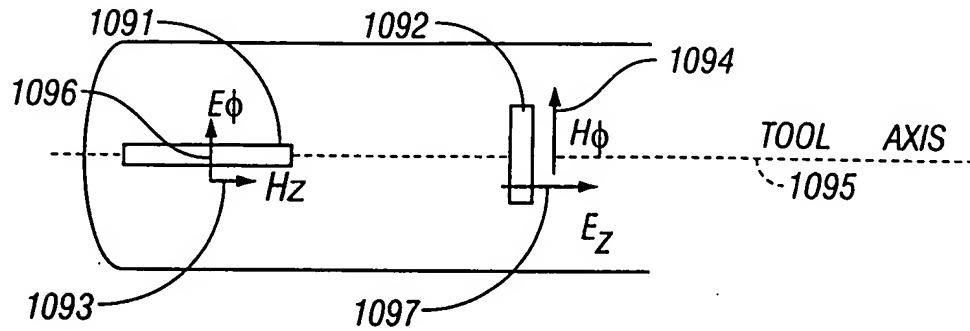


FIG. 50

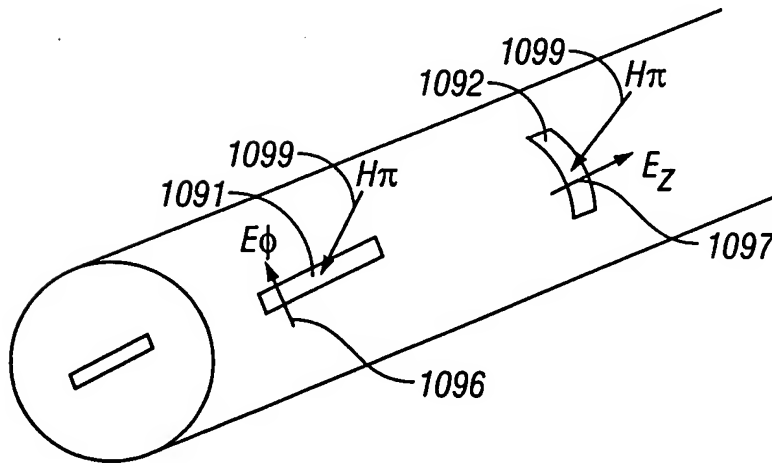


FIG. 51

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FILING DATE: AUGUST 7, 2002
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TELEPHONE NO.: 713-266-1130
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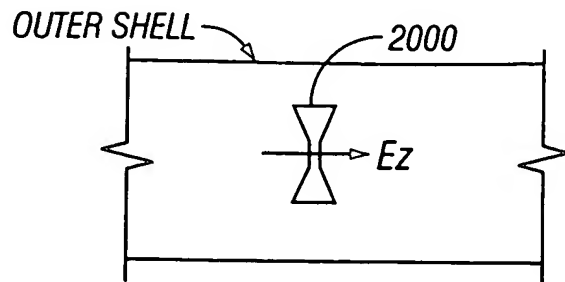


FIG. 52

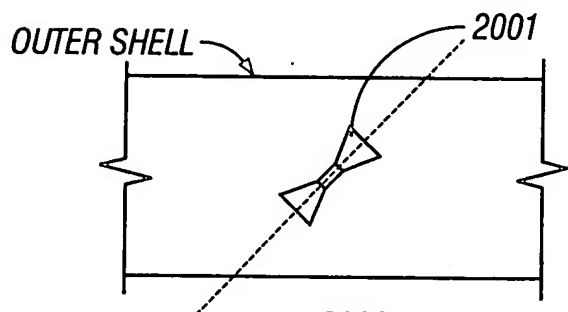


FIG. 53

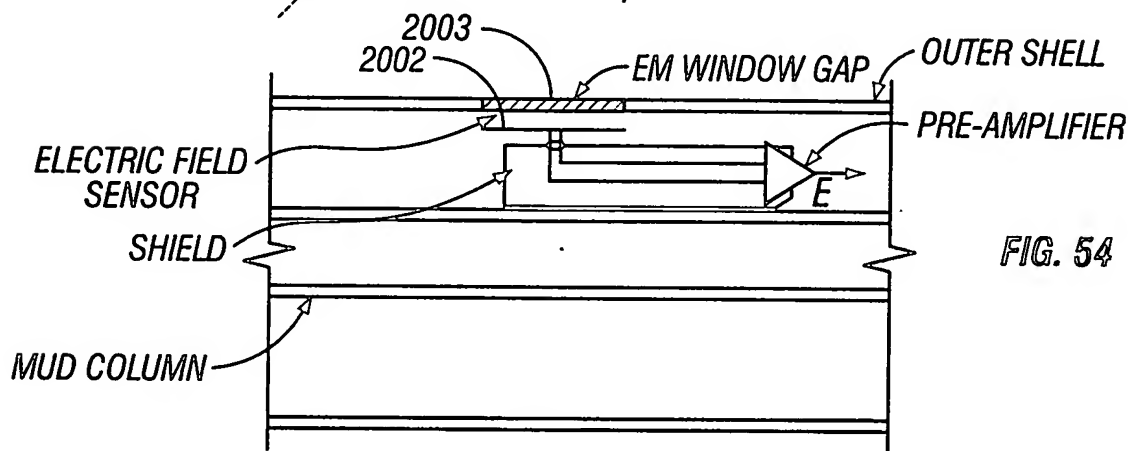


FIG. 54

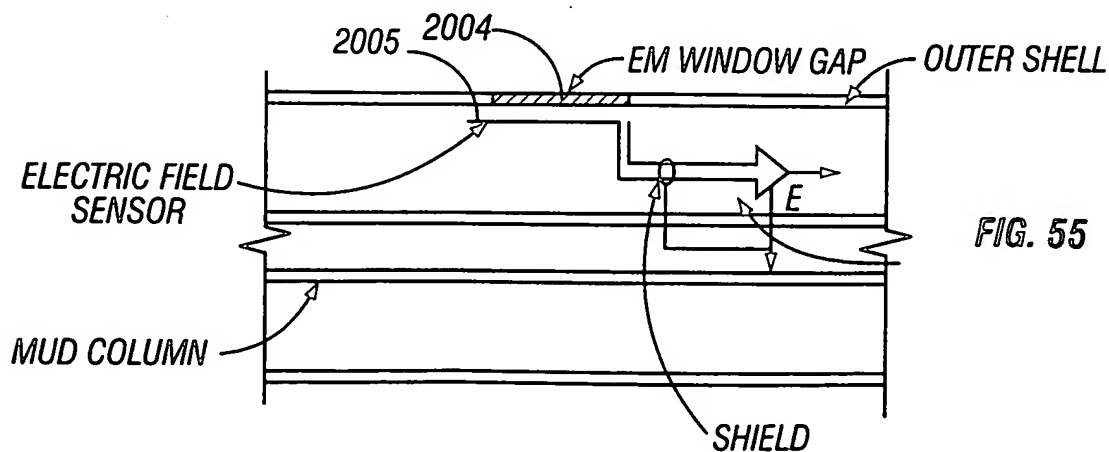


FIG. 55

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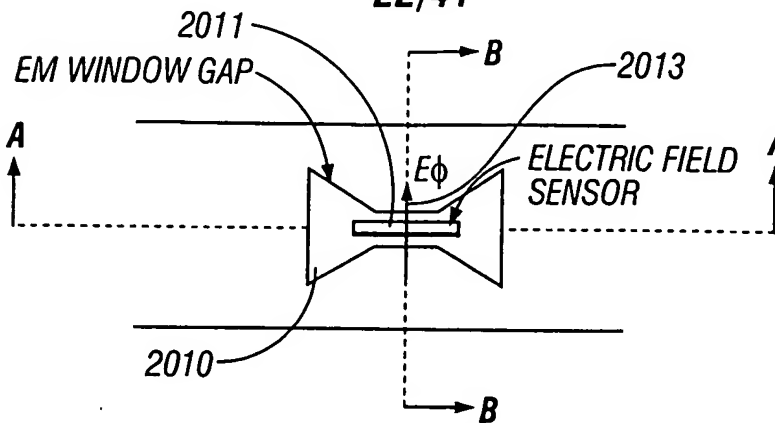


FIG. 56

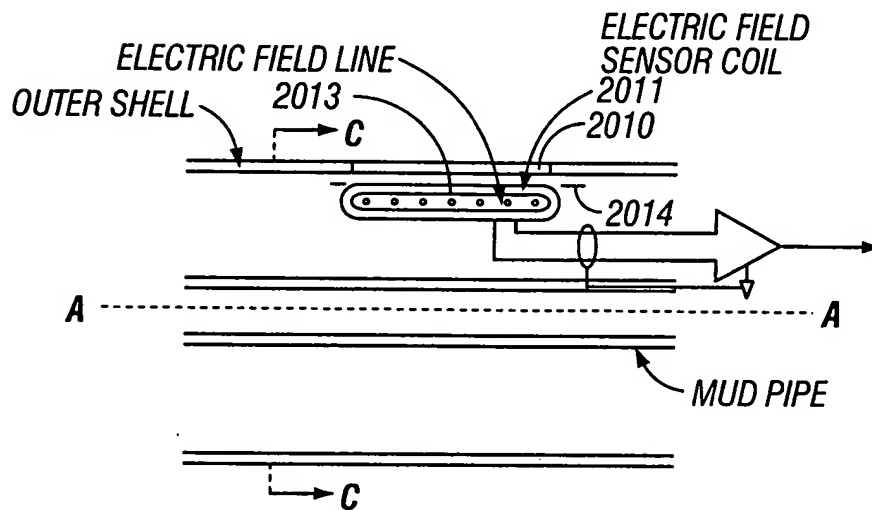


FIG. 57

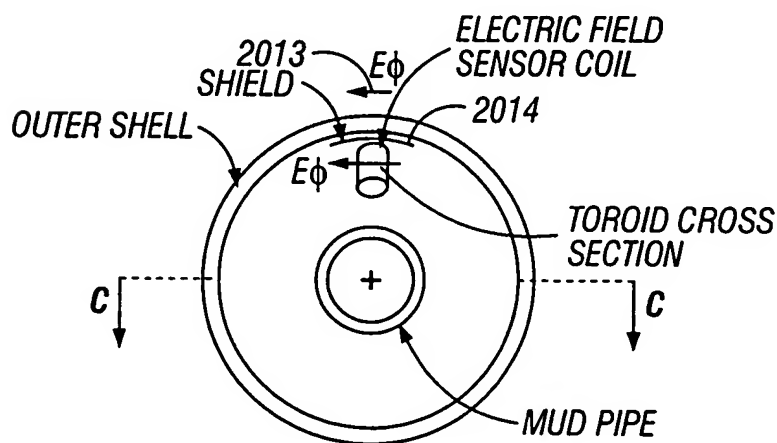


FIG. 58

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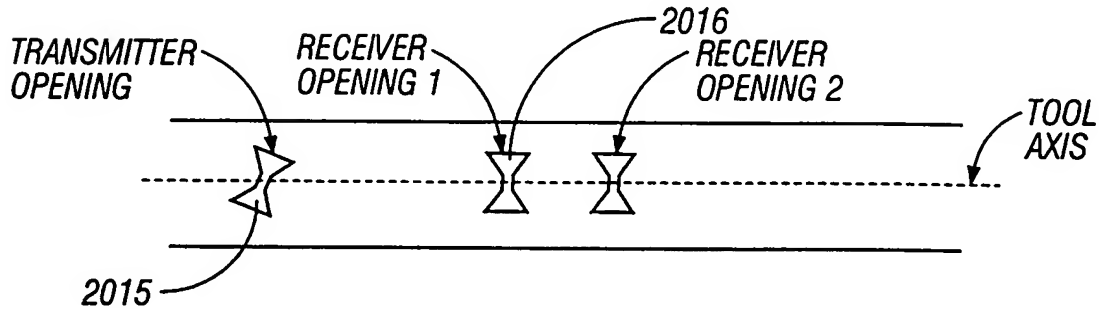


FIG. 59

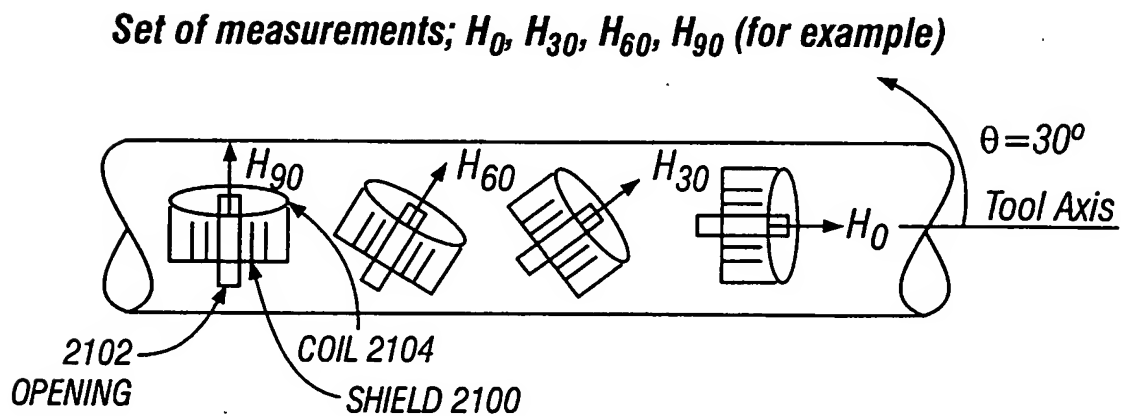


FIG. 60

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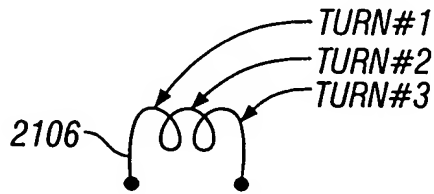


FIG. 61

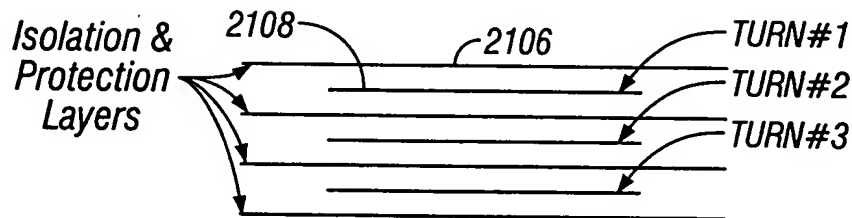


FIG. 62

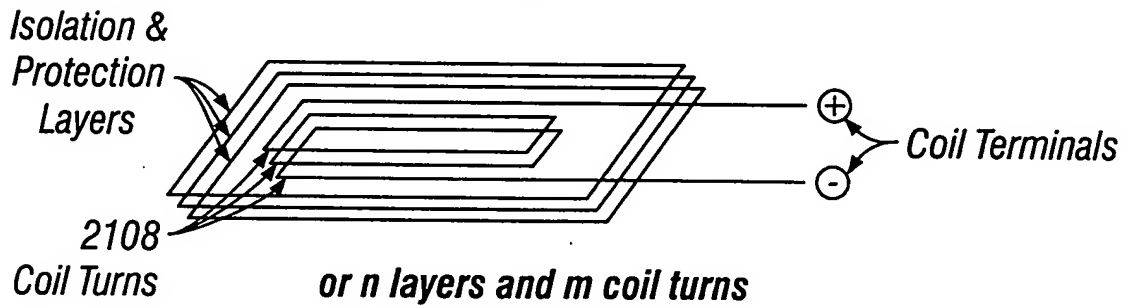


FIG. 63

2) At least one of the layers is a magnetic layer

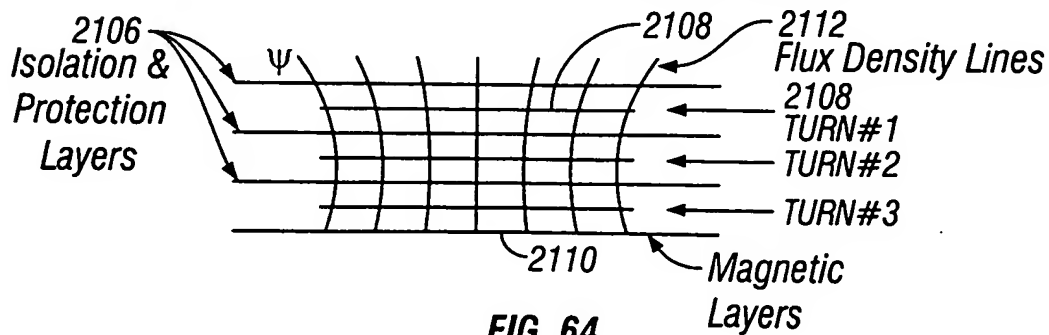


FIG. 64

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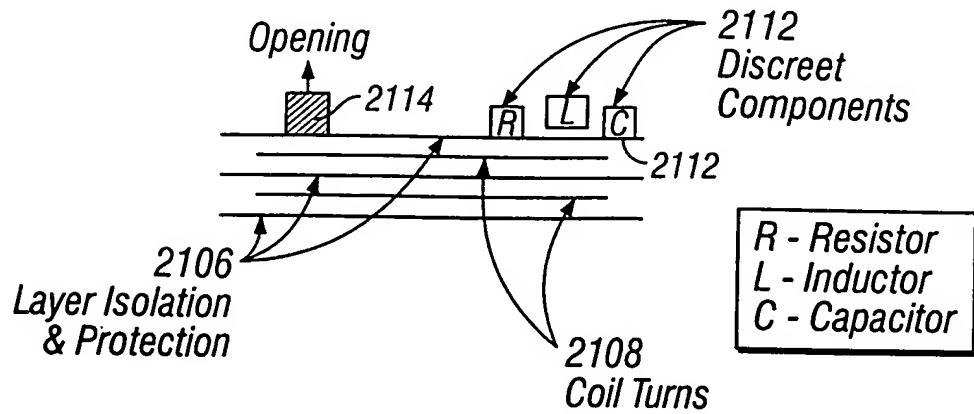


FIG. 65

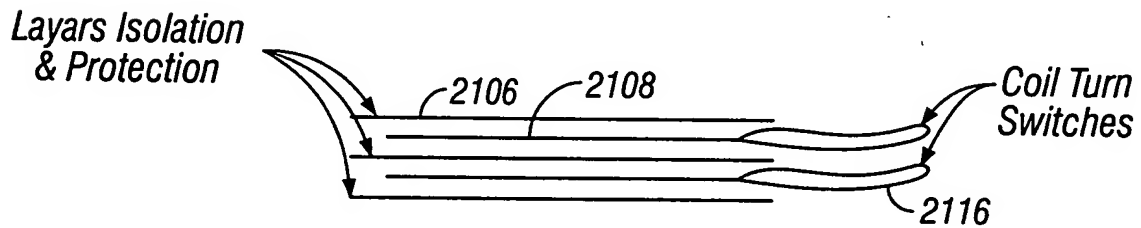


FIG. 66

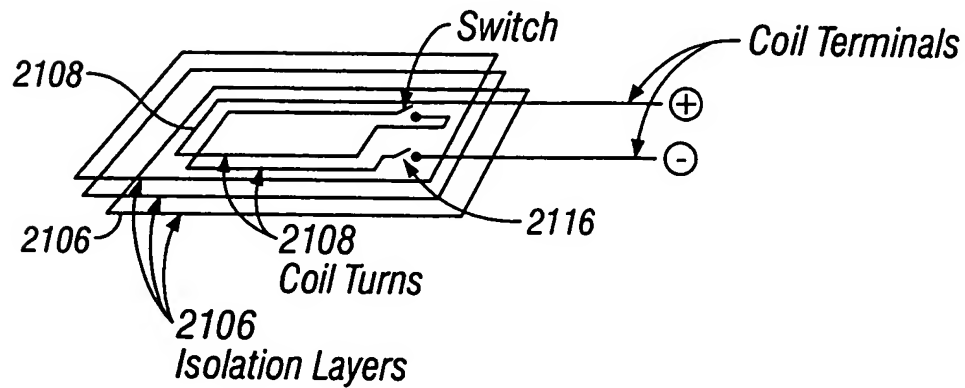


FIG. 67

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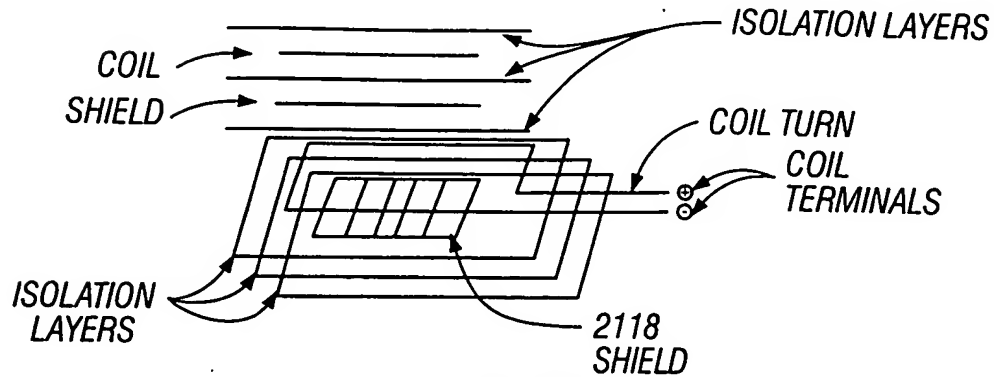


FIG. 68

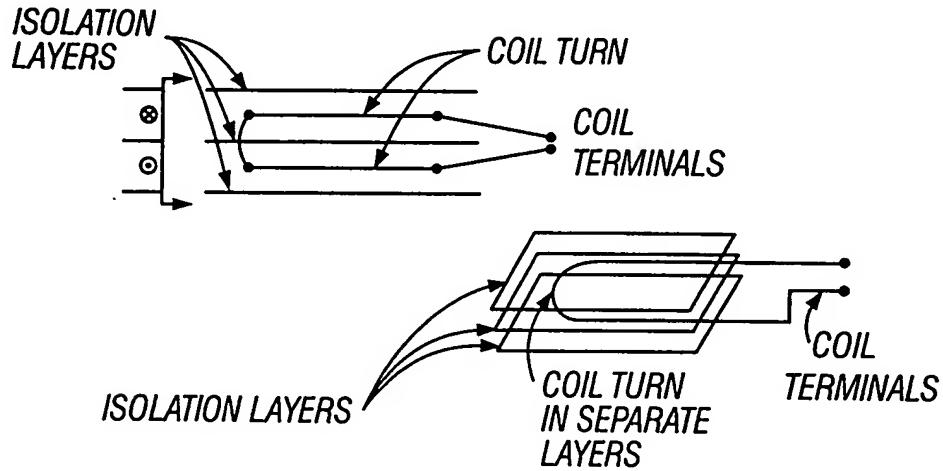


FIG. 69

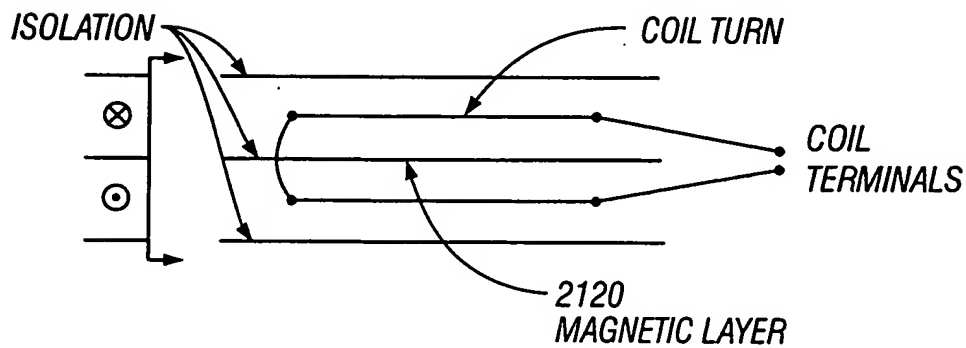


FIG. 70

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SYSTEM FOR GEOSTEERING AND FORMATION RESISTIVITY DATA INTERPRETATION IN
HORIZONTAL, VERTICAL AND DEVIATED WELLS

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10/214,436
G. MICHAEL ROEBUCK
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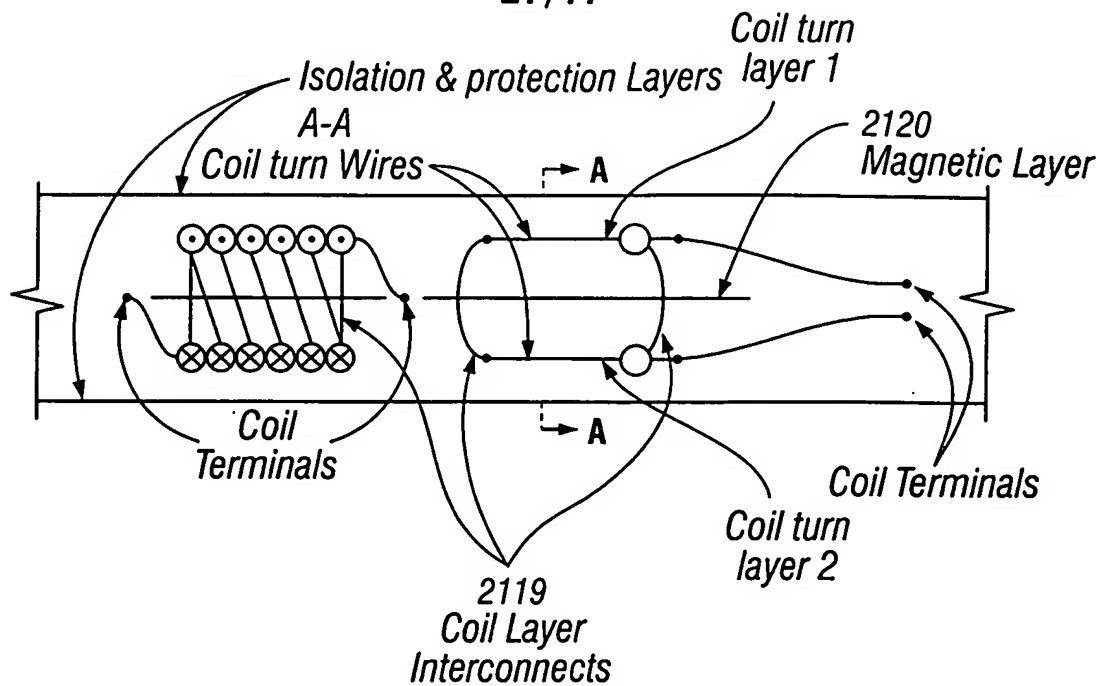


FIG. 71

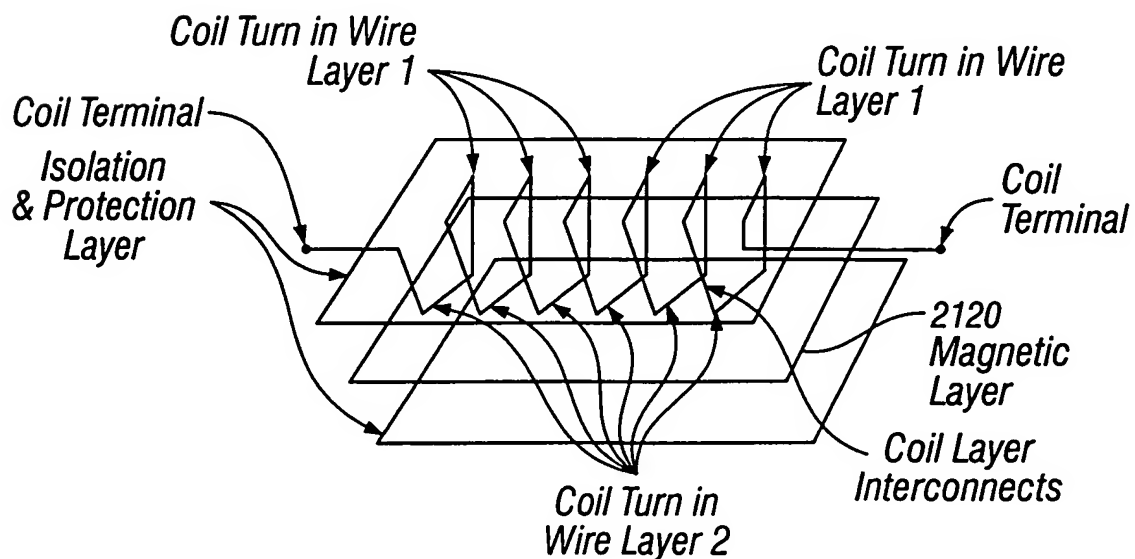


FIG. 72

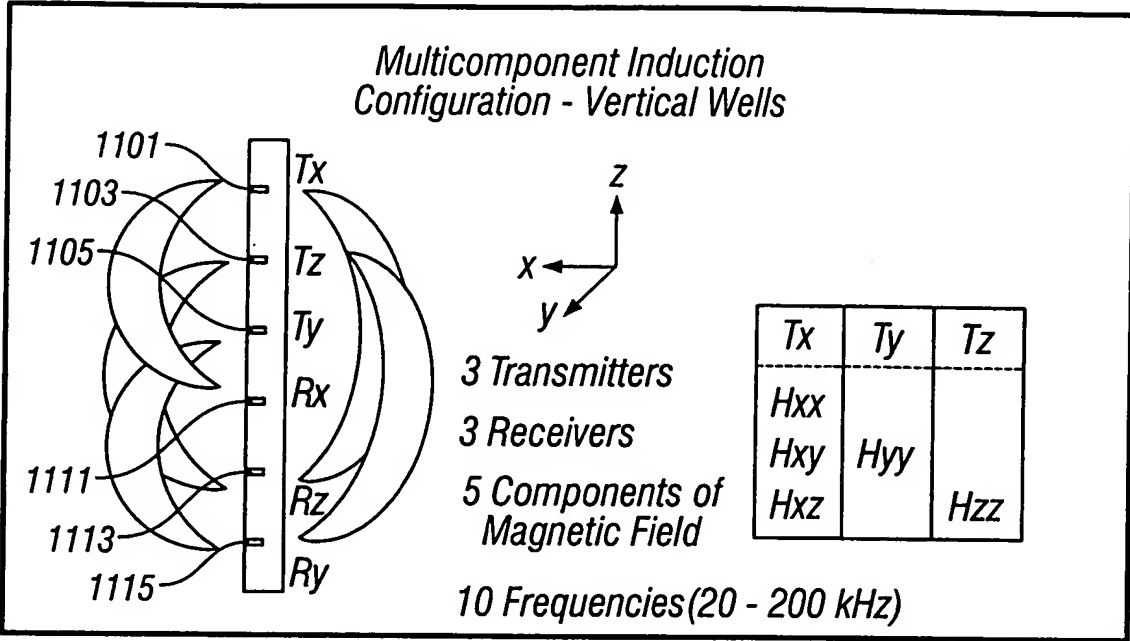


FIG. 73

Case 1:	Case 2:
1211 $R_h=1\text{ Ohm-m}, R_v=1\text{ Ohm-m}$	$R_h=2\text{ Ohm-m}, R_v=2\text{ Ohm-m}$ 1221
1213 $R_h=4\text{ Ohm-m}, R_v=10\text{ Ohm-m}$	$R_h=4\text{ Ohm-m}, R_v=10\text{ Ohm-m}$ 1223
1215 $R_h=2\text{ Ohm-m}, R_v=2\text{ Ohm-m}$	$R_h=1\text{ Ohm-m}, R_v=1\text{ Ohm-m}$ 1225

FIG. 74

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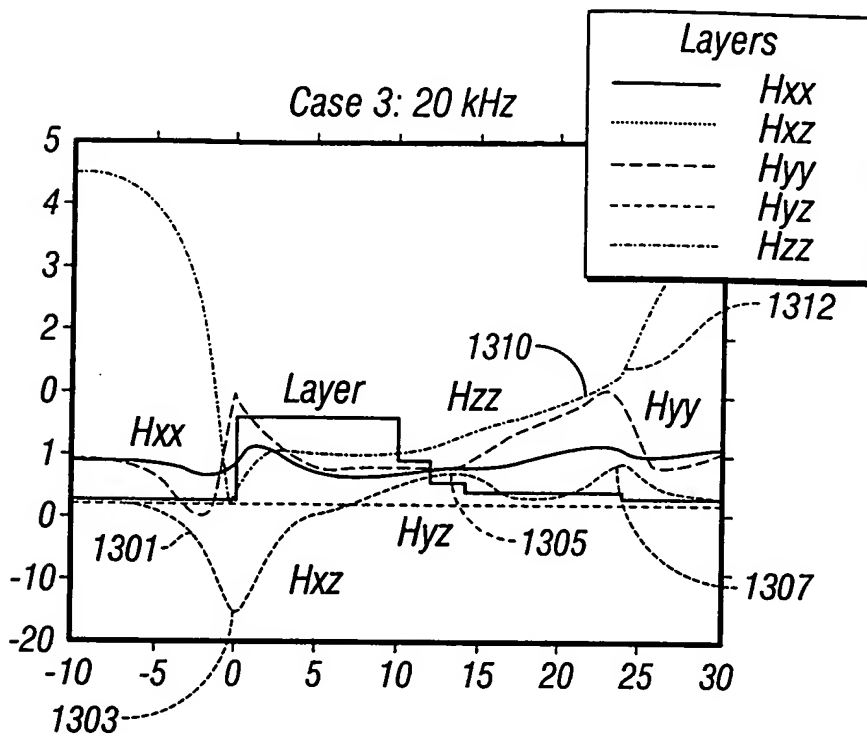


FIG. 75

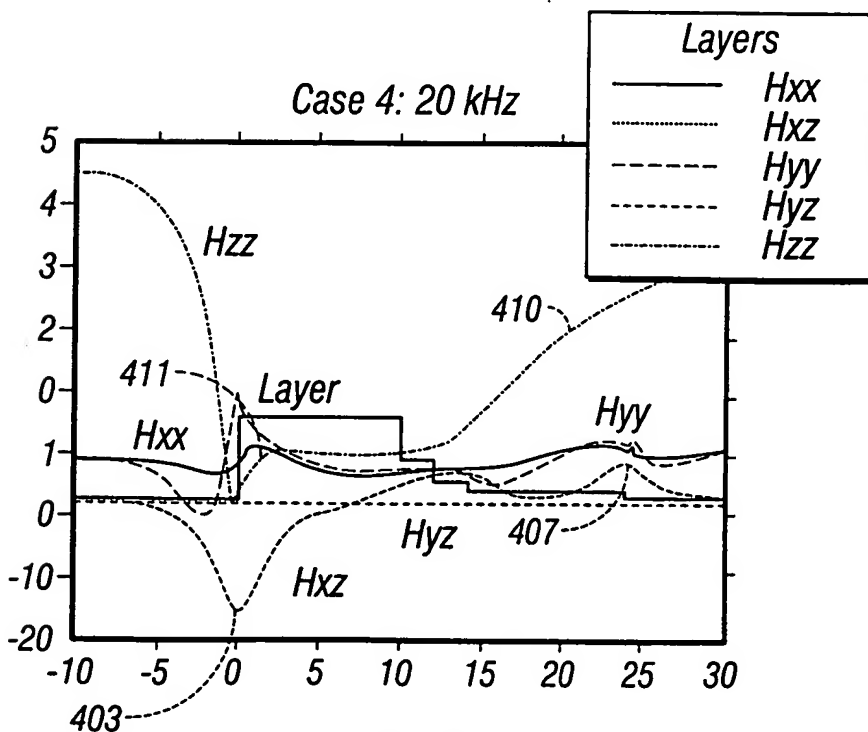


FIG. 76

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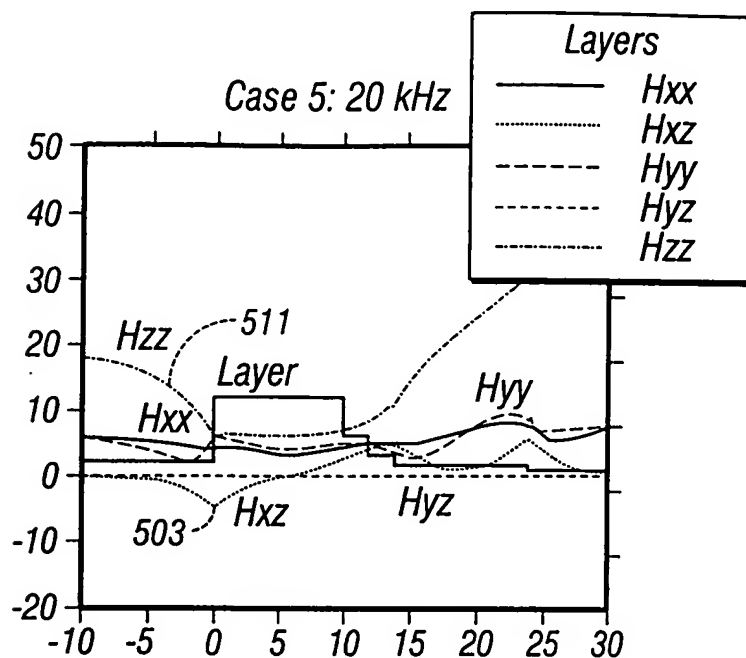


FIG. 77

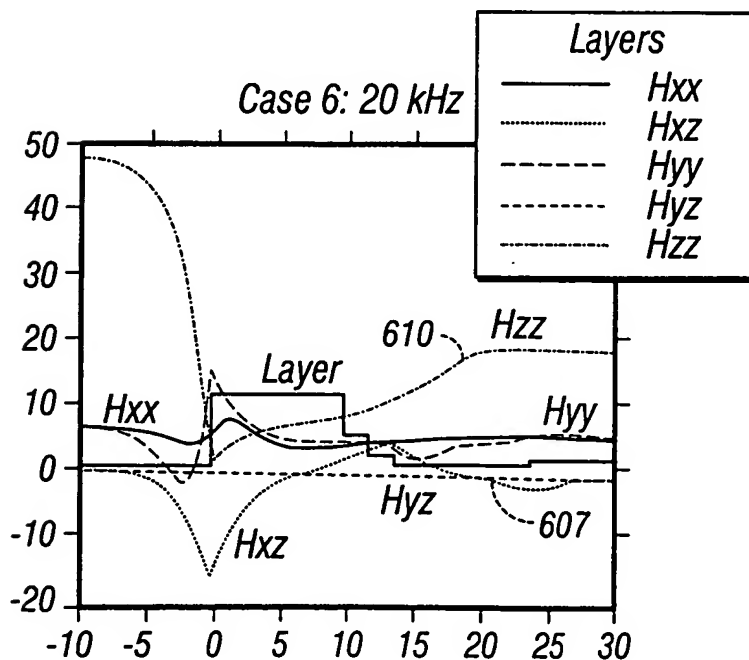


FIG. 78

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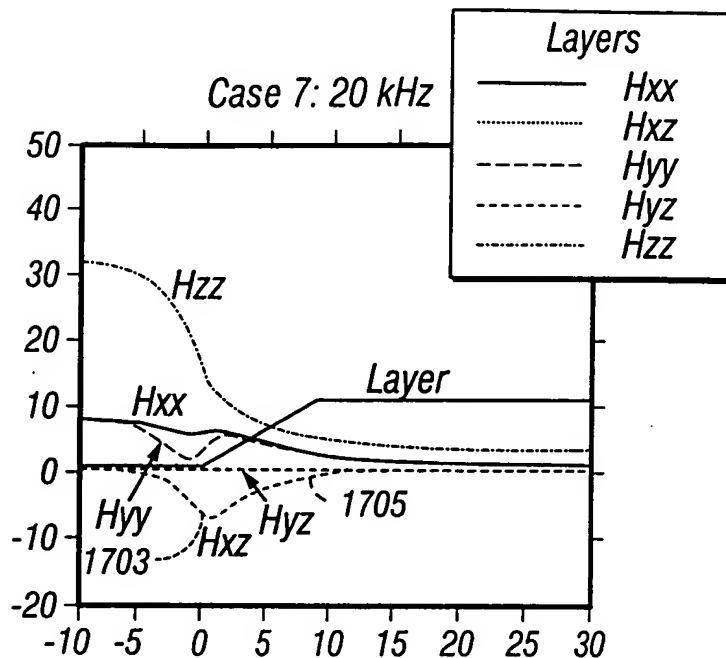


FIG. 79

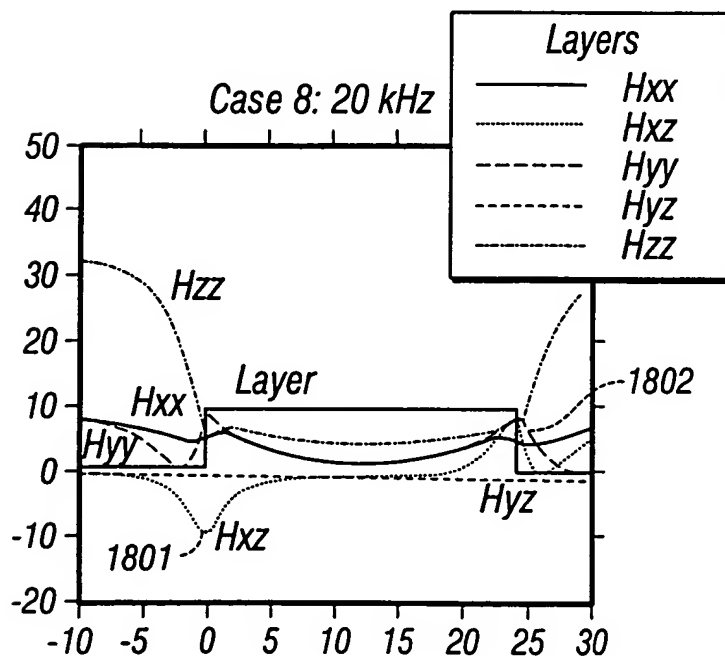
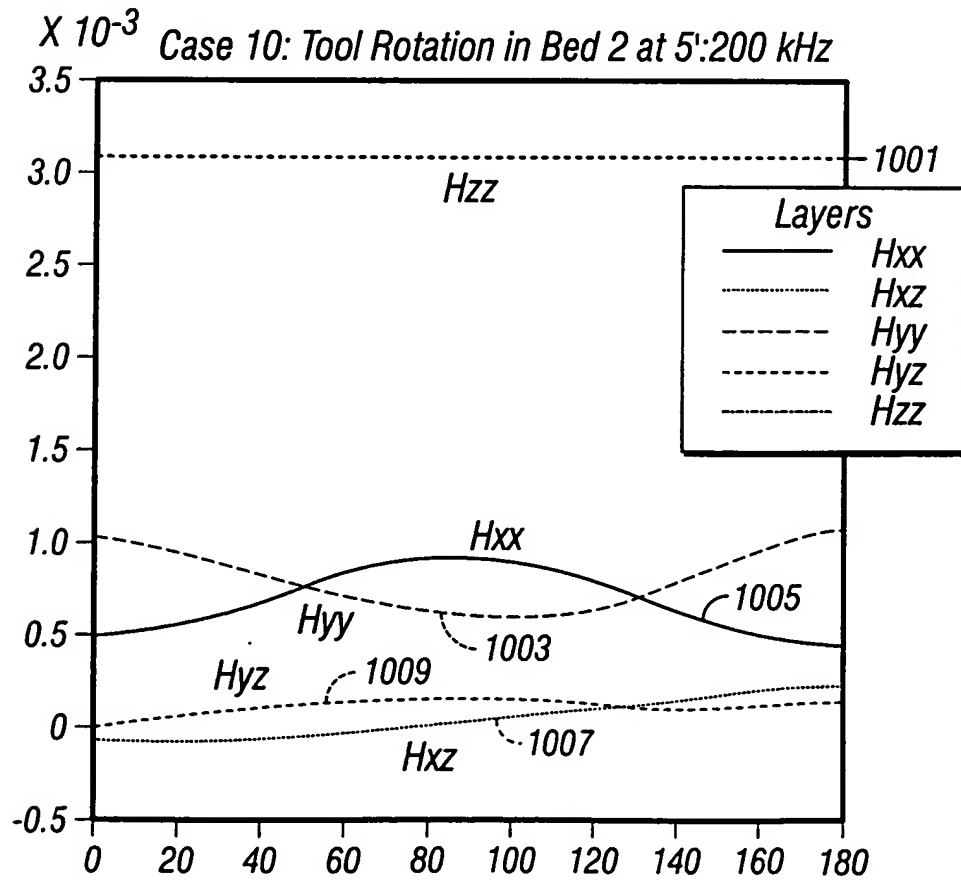
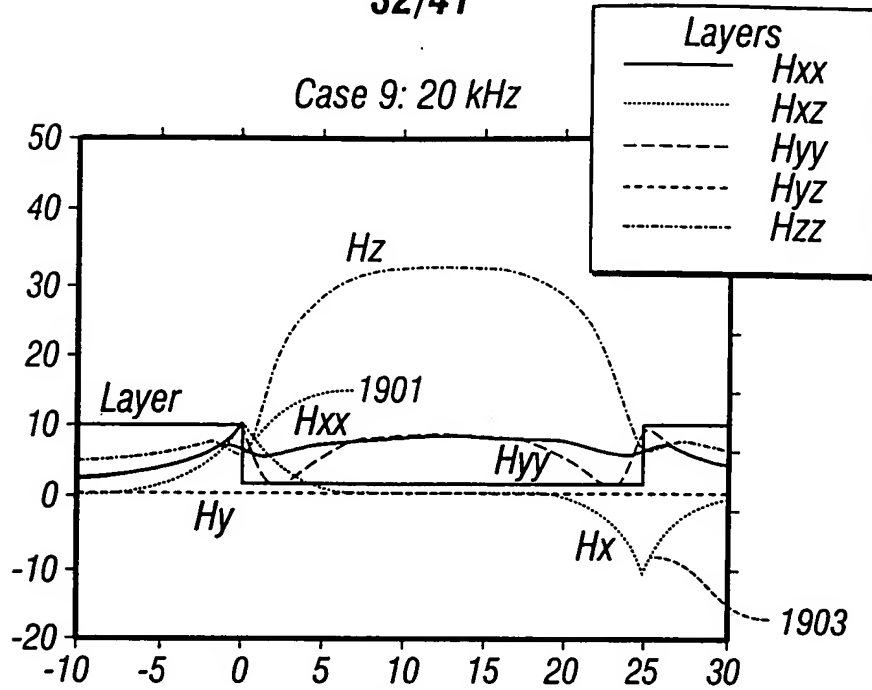


FIG. 80

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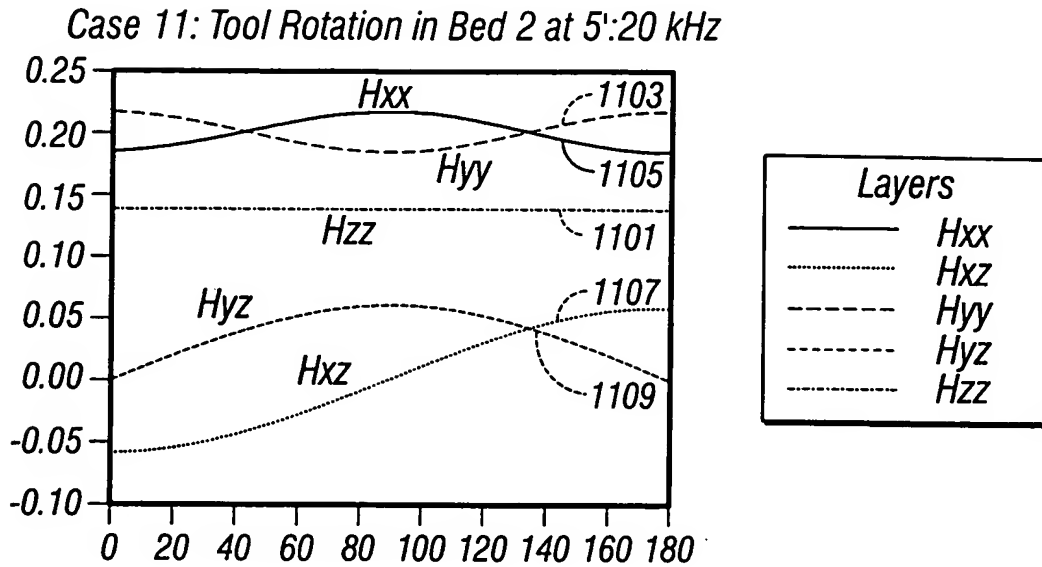


FIG. 83

Multicomponent Induction Configuration - Vertical wells

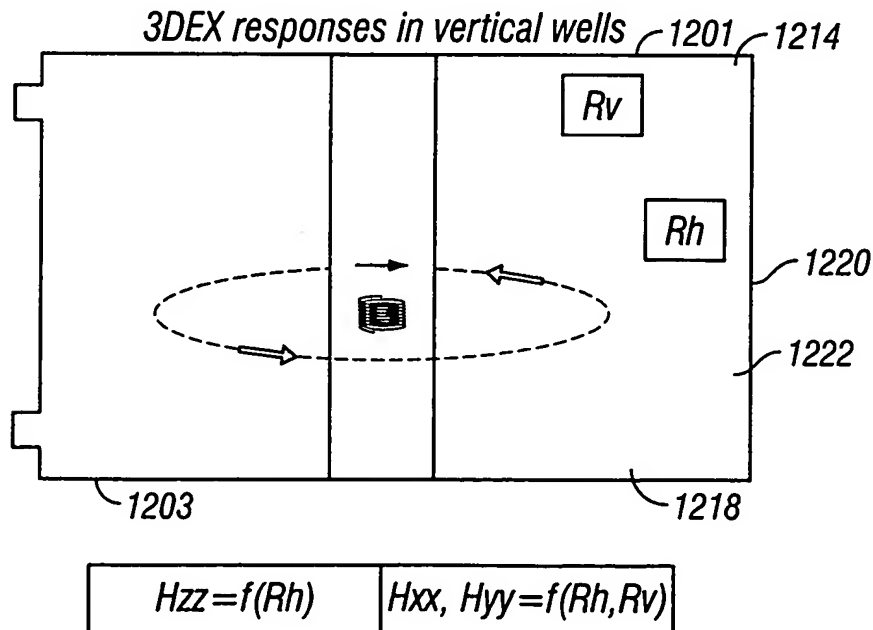
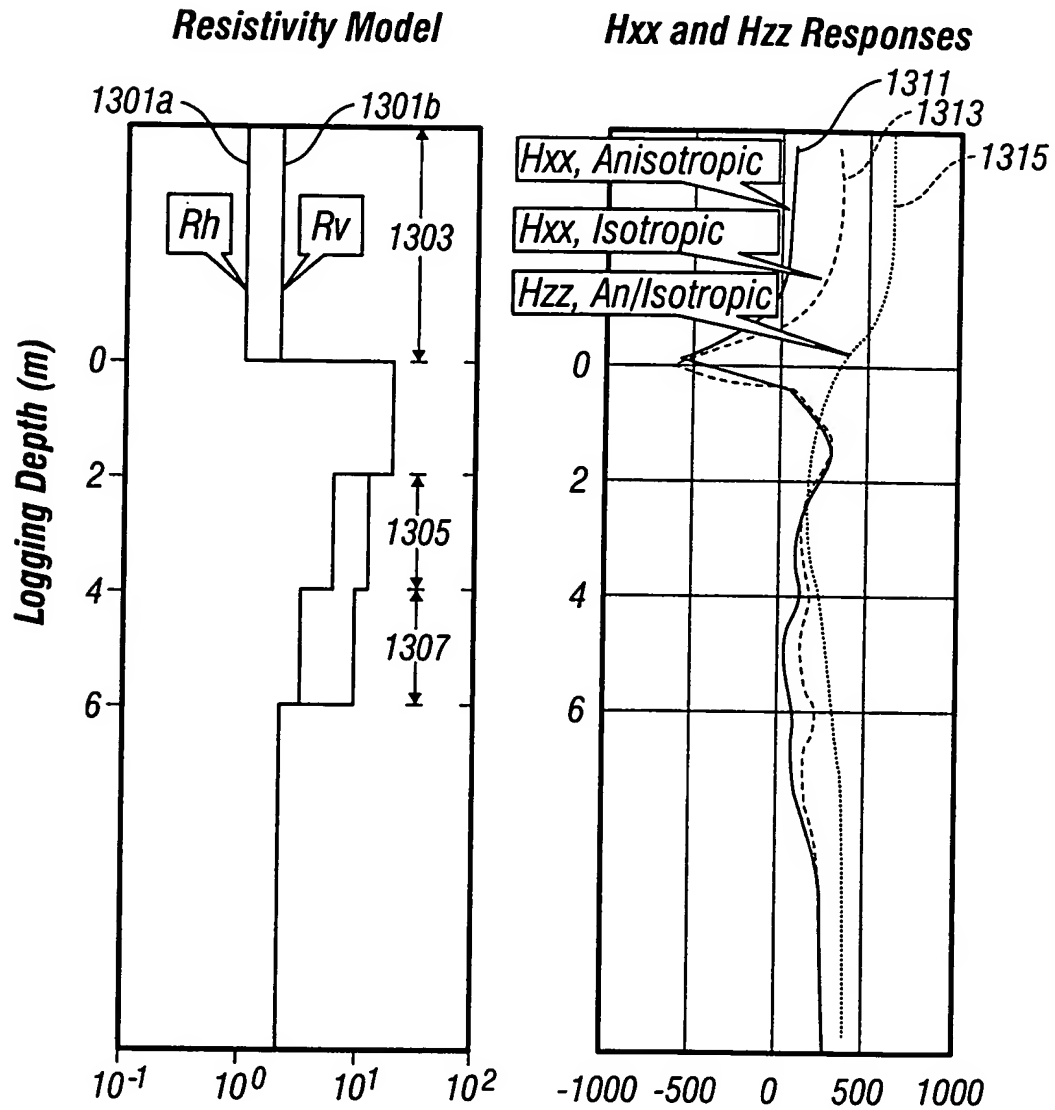


FIG. 84

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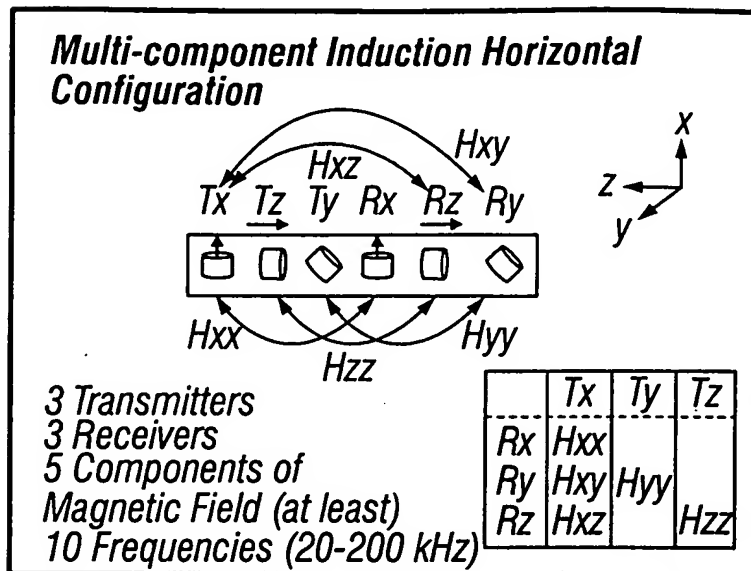


FIG. 86

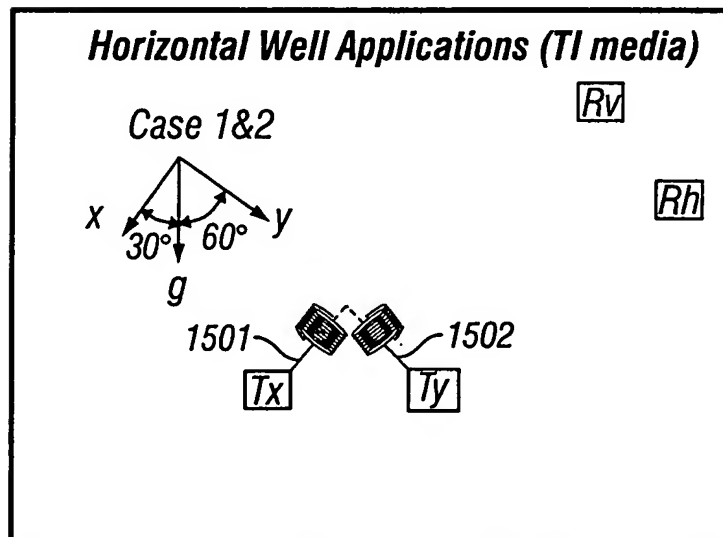


FIG. 87

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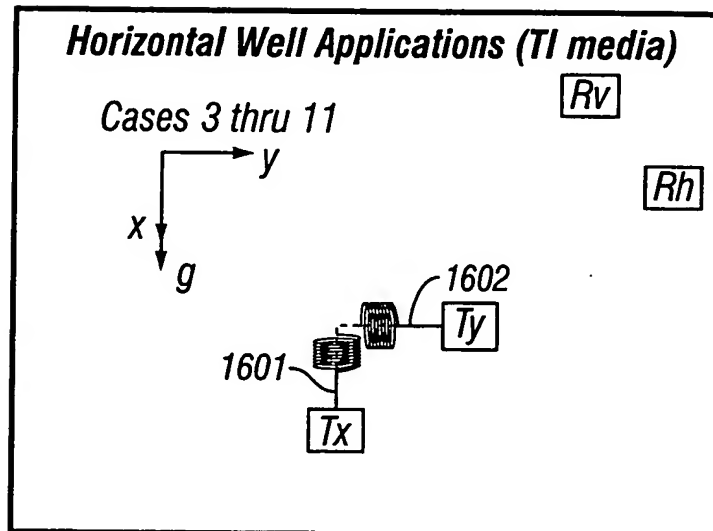


FIG. 88

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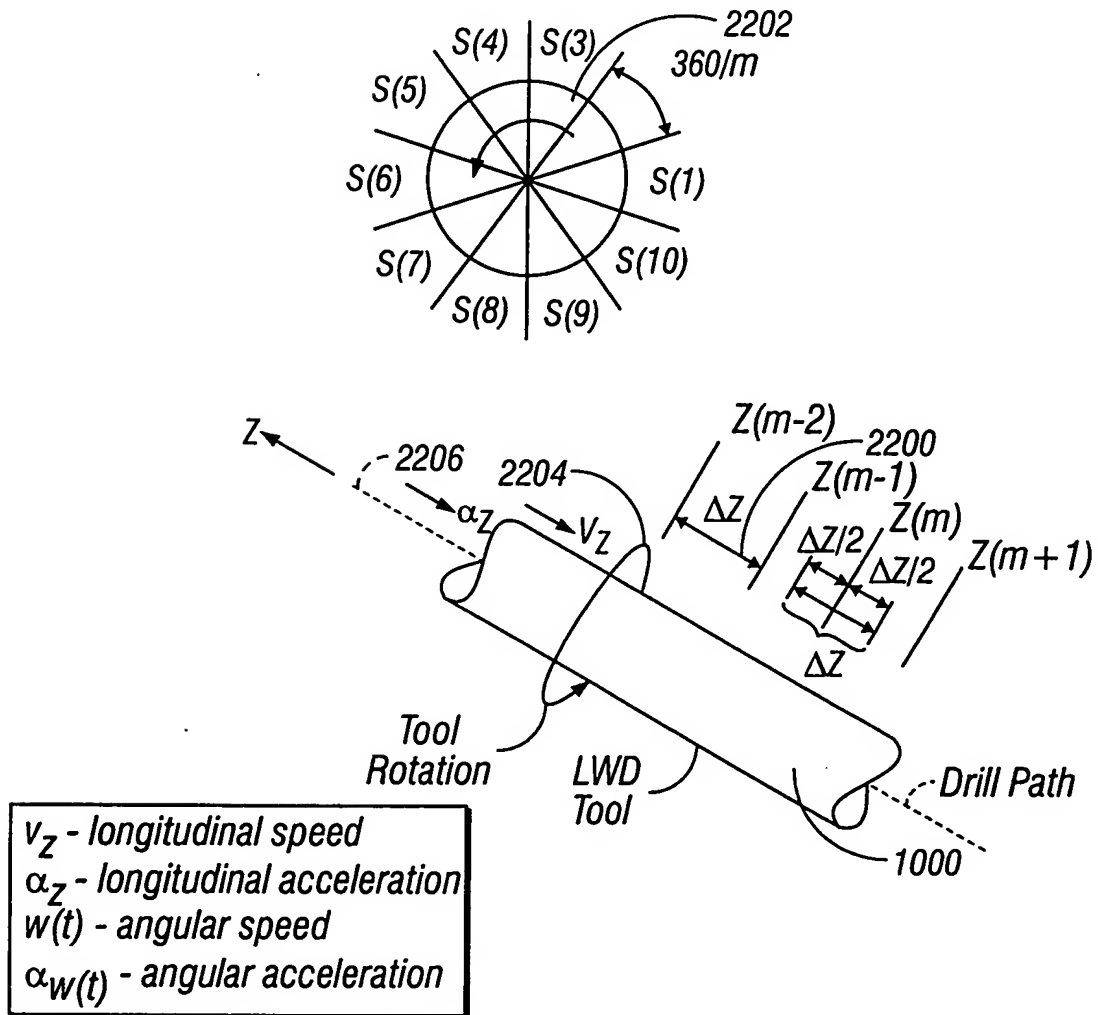


FIG. 89

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1) DATA AVERAGING ORGANIZATION
2D & Time Dependent CLUSTERED by Depth Interval & Azimuthal Sector

	S(1)	S(2)	S(3)	...	S(9)	S(10)
° °	° °	° °	° °		° °	° °
Z(m-1)	M(m-1,1)	M(m-1,2)	M(m-1,3)	°	M(m-1,9)	M(m-1,10)
Z(m)	M(m,1)	M(m,2)	M(m,3)	°	M(m,9)	M(m,10)
Z(m+1)	M(m+1,1)	M(m+1,2)	M(m+1,3)	°	M(m+1,9)	M(m+1,10)
° °	° °	° °	° °		° °	° °

M(m,R)
m → Depth Interval Index
R → Azimuthal Sector Number

FIG. 90

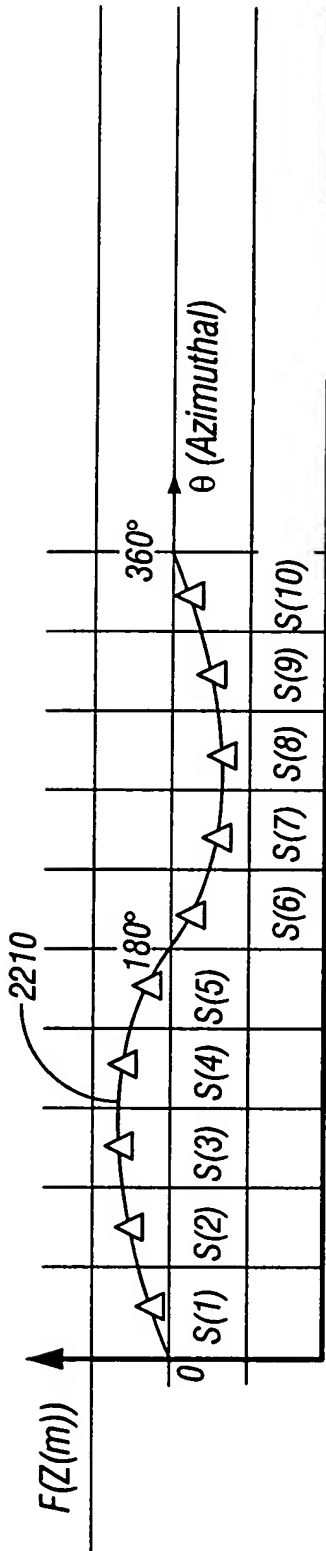


FIG. 91

II. TIME AVERAGING:

$$M(m,R) = \text{AVERAGE}[\bar{f}(RD_{(m_2,r_2,t_i)})]$$

RD-Raw Data at Depth Interval m , Sector R
And Time T_i

$$T\mu(m,R) = \frac{T_{RD}(m,R)}{\sqrt{N}}$$

FIG. 93

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Periodicity:

$H_{zz} \Rightarrow$ not sensitive to tool rotation.

H_{xx} & $H_{yy} \Rightarrow$ two cycles per tool complete rotation.

H_{yz} & $H_{xz} \Rightarrow$ one cycle per tool complete rotation.

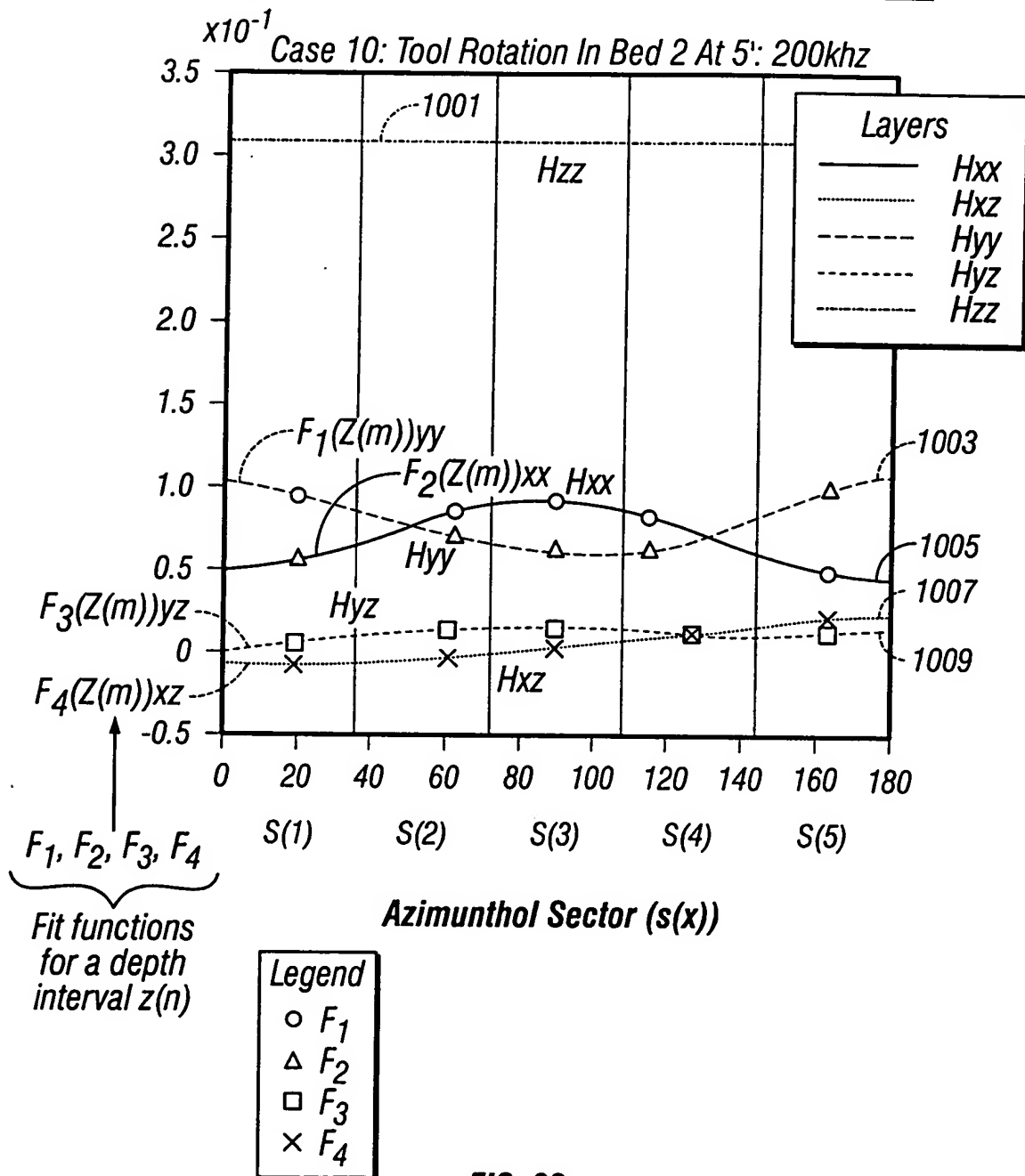


FIG. 92

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